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User Manual

Basic Configuration
EAGLE20/30

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Printed in Germany
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Rel. 1.0 - 09/2012 – 21.9.12

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About this Manual

The “Basic Configuration” user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The following thematic sequence has proven itself in practice:

- Set up device access for operation by entering the IP parameters
- Check the status of the software and update it if necessary
- Load/store any existing configuration
- Configure the ports
- Set up protection from unauthorized access
- Optimize the data transmission with network load control
- Synchronize system time in the network
- Perform an operation diagnosis
- Store the newly created configuration in the non-volatile memory.

The “GUI” reference manual contains detailed information on using the graphical interface to operate the individual functions of the device.

The “Command Line Interface” reference manual contains detailed information on using the Command Line Interface to operate the individual functions of the device.

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The Industrial HiVision Network Management Software provides you with additional options for smooth configuration and monitoring:

- Simultaneous configuration of multiple devices
- Graphic interface with network layout
- Auto-topology discovery
- Event log
- Event handling
- Client/server structure
- Browser interface
- ActiveX control for SCADA integration
- SNMP/OPC gateway.

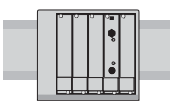
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in user interface
	Execution in the Graphical User Interface (Web-based Interface user interface)
	Execution in the Command Line Interface user interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch

	Bridge
	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

Introduction

The device has been developed for use in a harsh industrial environment. Accordingly, the installation process has been kept simple. Thanks to the selected default settings, you only have to enter a few settings before starting to operate the device.

Note: The changes you make in the dialogs are copied into the volatile memory of the device when you click on "Set".
To save the changes to the device into permanent memory, select the saving location in the `Basic Settings:Load/Save` dialog box and click on "Save".

1 Access to the user interfaces

The device provides you 2 user interfaces, which can be accessed through different interfaces:

- Command Line Interface (CLI) via the V.24 connection (out-of-band) and via SSH (in-band)
- Web-based interface via Ethernet (in-band).

1.1 Command Line Interface

The Command Line Interface enables you to use the functions of the device via a local or remote connection.
The Command Line Interface provides IT specialists with a familiar environment for configuring IT devices.
The script compatibility of the Command Line Interface enables you, among other things, to feed multiple devices with the same configuration data, to create and use partial configurations, or to compare 2 configurations using 2 script files.

You will find a detailed description of the Command Line Interface in the “Command Line Interface” reference manual.

You can access the Command Line Interface via:

- the V.24 port (out-of-band)
- SSH (in-band)

Note: To facilitate making entries, the CLI gives you the option of abbreviating keywords. Type in the beginning of a keyword. When you press the tab key, the CLI finishes the keyword.

Opening the Command Line Interface

☐ Connect the device via V.24:
  ☐ Connect the device with a terminal or with a "COM" port of a PC with terminal emulation based on VT100.
  ☐ Press a button on the keyboard.
  or
☐ Call the Command Line Interface via SSH.
  Users can access the Command Line Interface simultaneously with up to 5 sessions.

A window appears on the screen for the entry of the user name.

```
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EAGLE Release HiOS-01.0.00

                    (Build date 2012-04-20 11:12)



                  System Name   :  EAGLE-ECE5550113E0
                  Management-IP :  10.0.1.105
                  Subnet Mask   :  255.255.255.0
                  Base-MAC      :  00:80:63:4A:A7:B3
                  System Time   :  2012-04-25 06:11:23


User:
```

Figure 1: Logging in to the Command Line Interface program

- ☐ Enter a user name. The default setting for the user name is **admin** . Press the Enter key.
- ☐ Enter the password. The default setting for the password is **private** . Press the Enter key.
  You can change the user name and the password later in the Command Line Interface.
  Please note that these entries are case-sensitive.

The start screen appears.

```
NOTE: Enter '?' for Command Help. Command help displays all options
      that are valid for the particular mode.
      For the syntax of a particular command form, please
      consult the documentation.


(EAGLE) >
```

Figure 2: CLI screen after login

1.2 Web-based Interface

The user-friendly Web-based interface gives you the option of operating the device from any location in the network via a standard browser such as Mozilla Firefox or Microsoft Internet Explorer.
As a universal access tool, the Web browser uses an applet which communicates with the device via the Simple Network Management Protocol (SNMP).
The Web-based interface allows you to graphically configure the device.

System requirements

To open the graphical user interface, you need a Web browser, for example Mozilla Firefox version 3.5 or later, or Microsoft Internet Explorer version 6 or later.

Installation

Note: The graphical user interface uses Java 6 or Java 7.

Install the software from the enclosed CD-ROM. To do this, you go to “Additional Software”, select `Java Runtime Environment` and click on “Installation”.

Starting the graphic user interface

The prerequisite for starting the graphical user interface, first configure the IP parameters of the device correctly. The “Basic Configuration” user manual contains detailed information that you need to define the IP parameters.

- ☐ Start your Web browser.
- ☐ Activate Java in the security settings of your Web browser.
- ☐ Establish the connection by entering the IP address of the device which you want to administer via the Web-based management in the address field of the Web browser. Enter the address in the following form:
  `https://xxx.xxx.xxx.xxx`

  The login window appears on the screen.

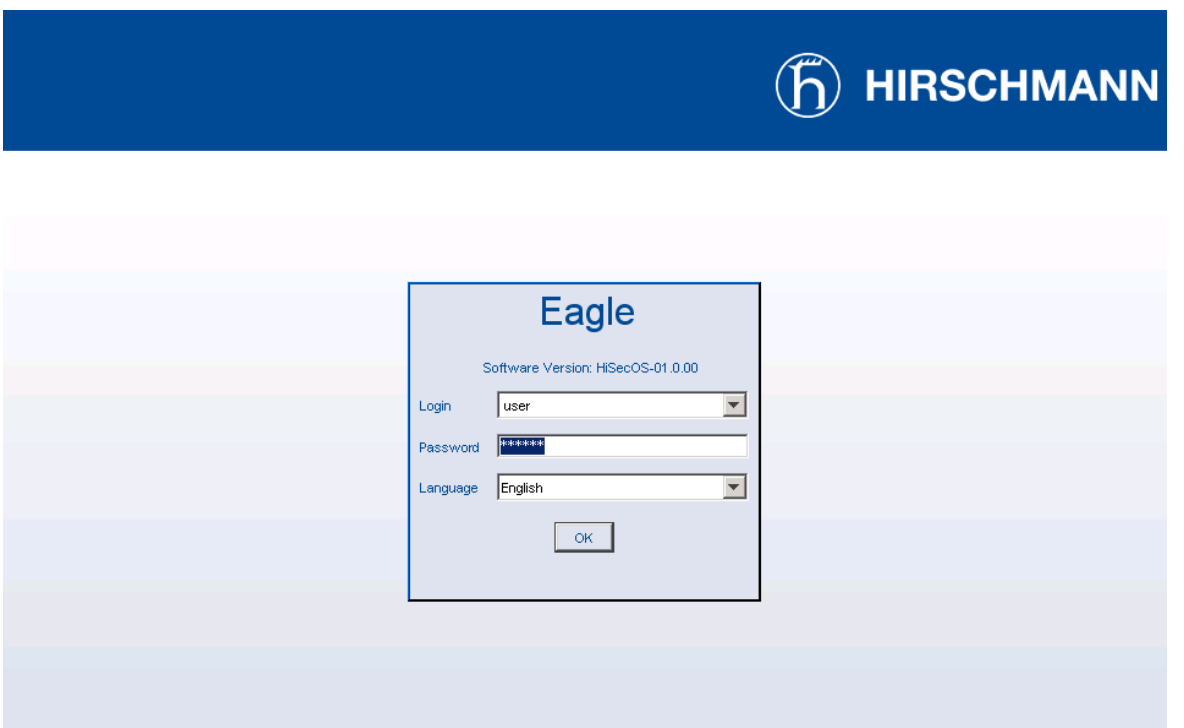


Figure 3: Login window

- ☐ Select the user name and enter the password.
- ☐ Select the language in which you want to use the graphic user interface.
- ☐ Click on OK.

The window with the graphic user interface will appear on the screen.

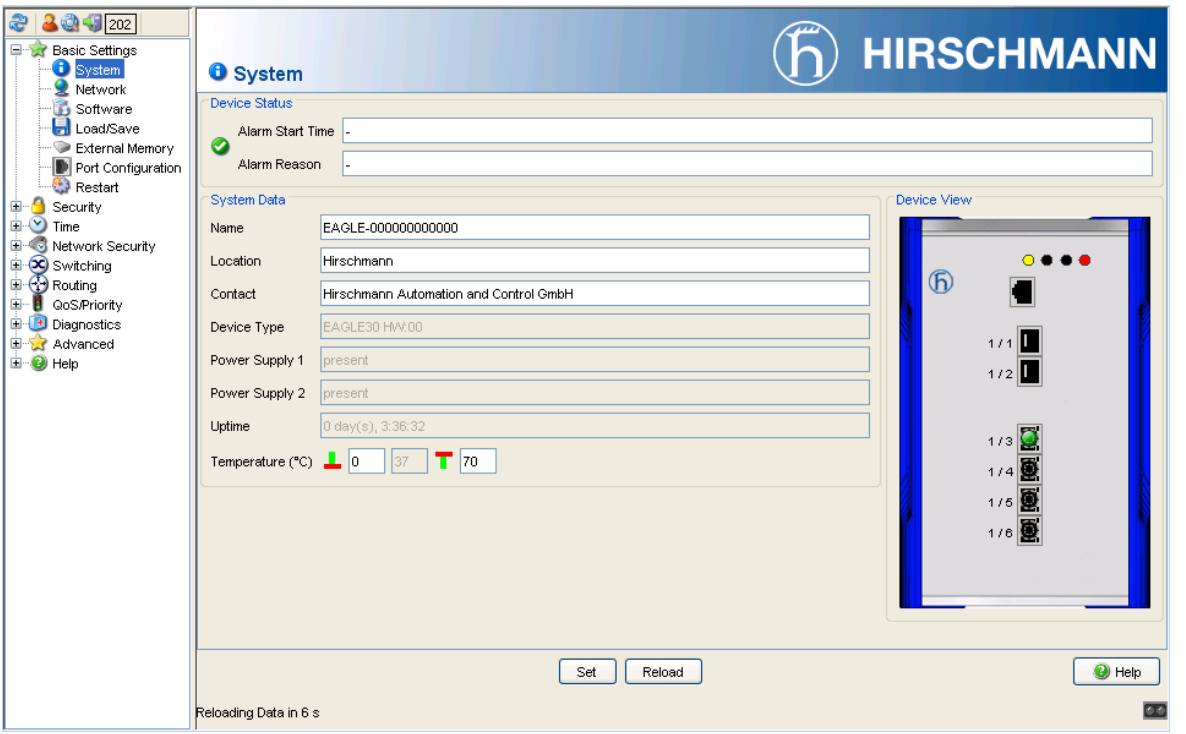


Figure 4: Graphic user interface of the device

Note: Unintentional changes to the device configuration may cause the connection between your PC and the device to be terminated. Before you change the settings in the device, switch on the function "Undo Modifications of Configuration" in the `Basic Settings:Load/Save` dialog. With this function, the device restores the active device configuration saved in the NVM if the connection is interrupted after the settings have been changed. The device remains reachable.

1.3 Authentication List

Authentication lists specify one or more authentication methods to validate access. Using the `Security:Authentication List` dialog you also manage the authentication application.

1.3.1 Authentication method

There are various methods with which the device authenticates a user. Configuring several user verification policies allows you to select every method of authentication. If a user is unable to authenticate with the first policy then the device uses the next policy for authentication. The device attempts authentication using every configured possibility. Possible methods are:

- local: Locally configured user accounts are used for the authentication.
- radius: A RADIUS server is used for the authentication.

1.3.2 Access Applications

The following access applications are available for accessing the device. Assign connection applications to 1 authentication list at a time.

- Console (V.24 connection)
- SSH
- Web Interface

1.4 User Management

Management access (system login) to the device, whether locally through the V.24 port or remotely through the network, is password-protected using a unique user ID and password combination dedicated to a specific user.

1.4.1 Privilege Levels

To allow for granular access control, a hierarchical, role-based user model is utilized. Users at specific levels are granted use of commands at the same or lower levels. The same privilege levels are applicable for every management interface, i.e. CLI, Web Interface and SNMPv3. Three privilege levels are available:

- Administrator
- Operator
- Guest
- the `unauthorized` privilege level is available for preparation of user authorization or to temporarily disable a user account. The user is not allowed access to the device at this privilege level.

Administrator
A user with this privilege level is authorized to manage local user accounts. With these rights you can administrate this device and using the following functions you can:

- Add, change or delete local user accounts
- Activate, deactivate or unlock local user accounts
- Change user passwords
- Configure password management

- Set or change the system time
- Load files to the device, e.g. device configurations, certificates or software images
- Reset settings to state on delivery
- Reset security settings to state on delivery
- Configure the RADIUS server and authentication lists
- Use CLI scripts
- Switch CLI logging and SNMP logging on and off
- Activate and deactivate external memories
- Activate and deactivate the system monitor
- Activate and deactivate services for management access (e.g. SNMP)
- Configure access restrictions to the user interface or the CLI on the basis of IP addresses

Operator

A user with the privilege level `operator` has configuration access. This excludes the the management functions described above. Furthermore, the features you are authorized access to with this privilege level include:

- Uploading files from the device to a host

Guest

The `guest` privilege level is a read-only account. At this level you are authorized to view the status of the device.

1.4.2 Establishing new user accounts

☐ Open the `Security:User Management` dialog.

☐ Click the "Create" button to open new user account dialog.

☐ In the "New Entry" frame, you enter the privilege level in the "Access Role" field:

- `unauthorized` - access is prohibited.
- `guest` - access to observe status of device.
- `operator` - limited management access to configure non-security relevant features.
- `administrator` - administration access
- To maintain a high level of password security it is recommended that you place a checkmark in the "Policy Check" checkbox.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`users add <user>`	To add new user account.
`users access-role <user> operator`	Specify snmpv3 access role for a user as operator.
`users password <user>`	Through this dialog the administrator is able to change the password of the new account.
`users enable <user>`	To activate user account.
`show users`	To confirm that the new user account has been established with proper attributes.

Note: Enter a password when you create a user in the CLI. Without entering a password for a new user, `*****` appears in the "Password" column of the web interface. Change this pseudo password so that the user has access to the device.

1.4.3 Disabling user accounts

- ☐ User accounts can be blocked by inserting a checkmark in the "User locked" checkbox. Only a user with an `administrator` privilege level has the authority to change this setting.
- ☐ The `unauthorized` access role will also deny a user access to the device. This feature is helpful in that you are able to maintain the account information for future reactivation.
- ☐ To permanently delete a user account, highlight the user to be deleted then click "Delete".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`users disable <user>`	To disable user account.
`users access-role <user> unauthorized`	This command will change the access role of a user to `unauthorized`, keeping the account information in the buffer memory.
`users delete <user>`	To permanently delete a user account.
`show users`	To confirm that the new user account has been established with proper attributes.

1.4.4 Passwords for Web access

Description of Password for Web Access

The passwords for local users follow a set of rules. Maintain these rules when creating each password. You use these rules to establish the strength of the password in the `Security:User Management` dialog, "Password Policy" frame.

Changing the password for Web access

If you have an user account without administrative access, you will have restricted write access to the device.

Note: Use between 5 and 32 characters for the password, since the device does not accept shorter passwords.

- ☐ Open the `Security:User Management` dialog.
- ☐ To enter a new password double click on the password field located in the "Password" column.
  In addition, specify password attributes in the "Password Policy" frame. When entering a new password a message will appear if the "Policy Check" option has been activated and the attribute conditions are not met.
- ☐ You save the new password by clicking "Set".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`users name <name> password`	Through this dialog the user is able to change the password.
`show users`	To confirm that the new user account has been established with proper attributes.

Passwords appear as `*****` after saving. Therefore, document password changes before saving. You cannot access the device without a valid password.

1.5 RADIUS Server

Managing and determining the validity and privileges of users in a large network can be significantly simplified and more secure by making use of a single database of accessible information as provided by a RADIUS (Remote Authentication Dial In User Service) server. The database within the RADIUS server stores information about clients, users, passwords and access privilege levels or roles, inlcuding the use of a shared secret.

1.5.1 Authentication Server

To validate users and terminals the device sends a request to a primary authentication server. If no response is received from the primary server the device sends a request to the secondary server if one has been configured. The device attempts to send a request to the active servers until it receives a response. Up to 8 Authentication servers can be configured.

- ☐ Open the `Security:RADIUS:Authentication Server` dialog.
- ☐ Click on "Create" to open the dialog window for entering the IP address of a RADIUS server.
- ☐ Confirm the entry of the IP address with "OK". Now you have created a new line in the table for this RADIUS server.
- ☐ In the "Secret" column you enter the character string which you get as a key from the administrator of your RADIUS server.
- ☐ With "Primary Server" you name this server as the first server which the device should contact for port authentication queries. If this server is not available, the device contacts the next server in the table.
- ☐ By clicking on "Delete" you delete the selected lines from the table.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`show radius auth servers`	Display the configured RADIUS Authentication servers. Select the next available index.
`radius server auth add 1 ip 10.0.1.153 name FIRST-RADIUS-svr`	Create a RADIUS primary authentication server with the ip address of 10.0.1.153.
`radius sever auth modify 1 secret`	Enter the shared secret password received from the server‘s administrator.
`show radius auth servers`	Display the configured RADIUS Authentication servers.

2 Entering the IP Parameters

When you install the device for the first time enter the IP parameters.

The device provides the following options for entering the IP parameters during the first installation:

- Entry using the Command Line Interface (CLI).
  You choose this “out of band” method if
  - you preconfigure your device outside its operating environment, or
  - you need to restore network access (“in-band”) to the device

  (see page 37 “Entering IP parameters via CLI”).
- Entry using the HiDiscovery protocol.
  You choose this “in-band” method if the device is already installed in the network or if you have another Ethernet connection between your PC and the device
  (see page 40 “Entering the IP Parameters via HiDiscovery”).
- Configuration via the Web-based interface.
  If the device already has an IP address and can be reached via the network, then the Web-based interface provides you with another option for configuring the IP parameters.

2.1 IP Parameter Basics

2.1.1 IP Address (Version 4)

The IP addresses consist of 4 bytes. These 4 bytes are written in decimal notation, separated by a decimal point.

Since 1992, five classes of IP address have been defined in the RFC 1340.

Class	Network address	Host address	Address range
A	1 byte	3 bytes	0.0.0.0 to 127.255.255.255
B	2 bytes	2 bytes	128.0.0.0 to 191.255.255.255
C	3 bytes	1 byte	192.0.0.0 to 223.255.255.255
D			224.0.0.0 to 239.255.255.255
E			240.0.0.0 to 255.255.255.255

Table 1: IP address classes

The network address is the fixed part of the IP address. The worldwide leading regulatory board for assigning network addresses is the IANA (Internet Assigned Numbers Authority). If you require an IP address block, contact your Internet service provider. Internet service providers should contact their local higher-level organization:

- APNIC (Asia Pacific Network Information Center) - Asia/Pacific Region
- ARIN (American Registry for Internet Numbers) - Americas and Sub-Sahara Africa
- LACNIC (Regional Latin-American and Caribbean IP Address Registry) – Latin America and some Caribbean Islands
- RIPE NCC (Réseaux IP Européens) - Europe and Surrounding Regions

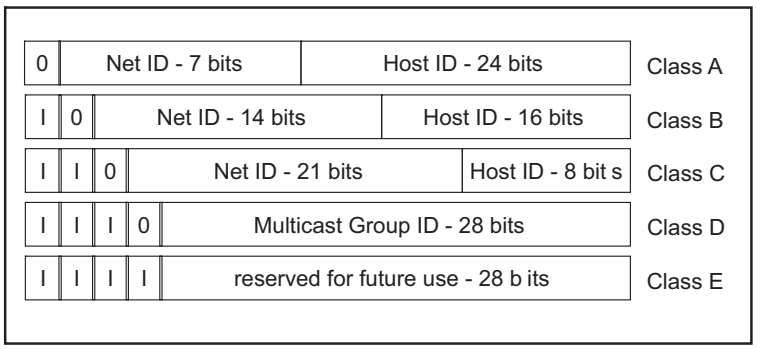


Figure 5: Bit representation of the IP address

All IP addresses belong to class A when their first bit is a zero, i.e. the first decimal number is less than 128.
The IP address belongs to class B if the first bit is a one and the second bit is a zero, i.e. the first decimal number is between 128 and 191.
The IP address belongs to class C if the first two bits are a one, i.e. the first decimal number is higher than 191.

Assigning the host address (host ID) is the responsibility of the network operator. He alone is responsible for the uniqueness of the IP addresses he assigns.

2.1.2 Netmask

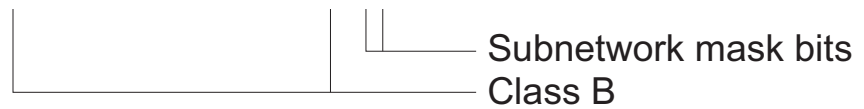
Routers and gateways subdivide large networks into subnetworks. The netmask assigns the IP addresses of the individual devices to a particular subnetwork.

The division into subnetworks with the aid of the netmask is performed in much the same way as the division of the network addresses (net id) into classes A to C.

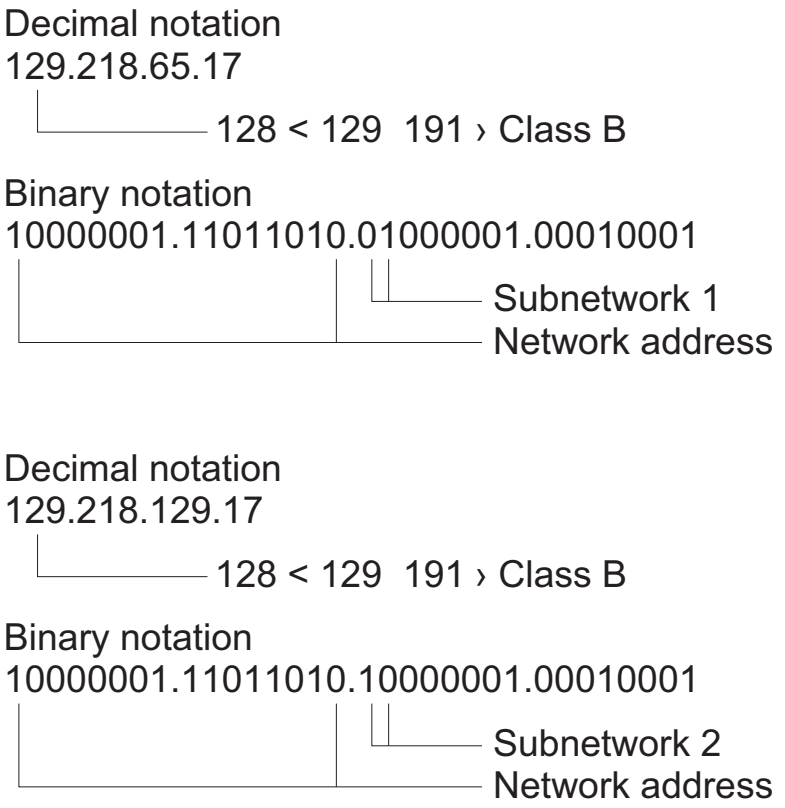
The bits of the host address (host id) that represent the mask are set to one. The remaining bits of the host address in the netmask are set to zero (see the following examples).
Example of a netmask:

Decimal notation
255.255.192.0

Binary notation
11111111.11111111.11000000.00000000



Example of IP addresses with subnetwork assignment when the above subnet mask is applied:


Decimal notation
129.218.65.17
128 < 129 191 › Class B
Binary notation
10000001.11011010.01000001.00010001
Subnetwork 1
Network address
Decimal notation
129.218.129.17
128 < 129 191 › Class B
Binary notation
10000001.11011010.10000001.00010001
Subnetwork 2
Network address

Example of how the network mask is used

In a large network it is possible that gateways and routers separate the management agent from its management station. How does addressing work in such a case?

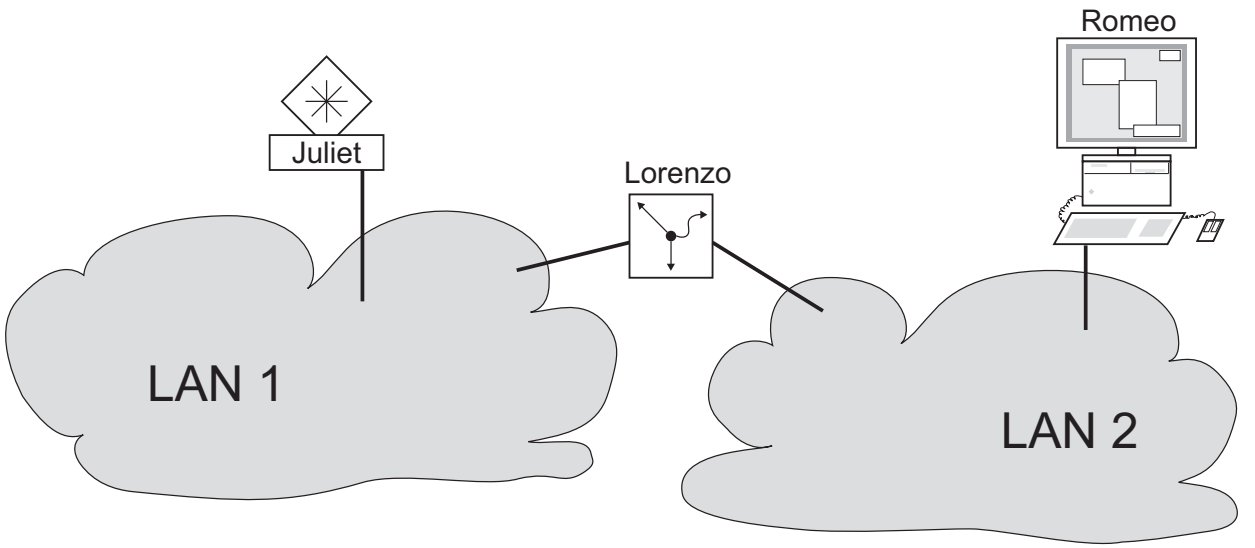


Figure 6: Management agent that is separated from its management station by a router

The management station "Romeo" wants to send data to the management agent "Juliet". Romeo knows Juliet's IP address and also knows that the router "Lorenzo" knows the way to Juliet.

Romeo therefore puts his message in an envelope and writes Juliet's IP address as the destination address. For the source address he writes his own IP address on the envelope.

Romeo then places this envelope in a second one with Lorenzo's MAC address as the destination and his own MAC address as the source. This process is comparable to going from layer 3 to layer 2 of the ISO/OSI base reference model.

Finally, Romeo puts the entire data packet into the mailbox. This is comparable to going from layer 2 to layer 1, i.e. to sending the data packet over the Ethernet.

Lorenzo receives the letter and removes the outer envelope. From the inner envelope he recognizes that the letter is meant for Juliet. He places the inner envelope in a new outer envelope and searches his address list (the ARP table) for Juliet's MAC address. He writes her MAC address on the outer envelope as the destination address and his own MAC address as the source address. He then places the entire data packet in the mail box.

Juliet receives the letter and removes the outer envelope. She finds the inner envelope with Romeo's IP address. Opening the inner envelope and reading its contents corresponds to transferring the message to the higher protocol layers of the SO/OSI layer model.

Juliet would now like to send a reply to Romeo. She places her reply in an envelope with Romeo's IP address as destination and her own IP address as source. But where is she to send the answer? For she did not receive Romeo's MAC address. It was lost when Lorenzo replaced the outer envelope.

In the MIB, Juliet finds Lorenzo listed under the variable hmNetGatewayIPAddr as a means of communicating with Romeo. She therefore puts the envelope with the IP addresses in a further envelope with Lorenzo's MAC destination address.

The letter now travels back to Romeo via Lorenzo, the same way the first letter traveled from Romeo to Juliet.

2.1.3 Classless Inter-Domain Routing

Class C with a maximum of 254 addresses was too small, and class B with a maximum of 65,534 addresses was too large for most users. This resulted in ineffective usage of the class B addresses available.
Class D contains reserved multicast addresses. Class E is reserved for experimental purposes. A gateway not participating in these experiments ignores datagrams with these destination addresses.
Since 1993, RFC 1519 has been using Classless Inter-Domain Routing (CIDR) to provide a solution. CIDR overcomes these class boundaries and supports classless address ranges.

With CIDR, you enter the number of bits that designate the IP address range. You represent the IP address range in binary form and count the mask bits that designate the netmask. The netmask indicates the number of bits that are identical to the network part for the IP addresses in a given address range. Example:

IP address, decimal	Network mask, decimal	IP address, binary
149.218.112.1	255.255.255.128	10010101 11011010 01110000 00000001
149.218.112.127		10010101 11011010 01110000 01111111

25 mask bits

CIDR notation: 149.218.112.0/25

Mask bits

The combination of a number of class C address ranges is known as “supernetting”. This enables you to subdivide class B address ranges to a very fine degree.

2.2 Entering IP parameters via CLI

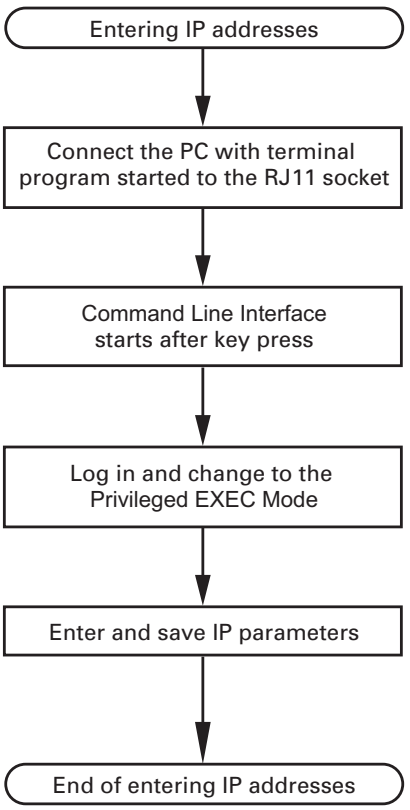

Entering IP addresses
Connect the PC with terminal program started to the RJ11 socket
Command Line Interface starts after key press
Log in and change to the Privileged EXEC Mode
Enter and save IP parameters
End of entering IP addresses

Figure 7: Flow chart for entering IP addresses

Note: If there is no terminal or PC with terminal emulation available in the vicinity of the installation location, you can configure the device at your own workstation, then take it to its final installation location.

☐ Set up a connection to the device (see on page 14 “Command Line Interface”).

The start screen appears.

```
NOTE: Enter '?' for Command Help. Command help displays all options
      that are valid for the 'normal' and 'no' command forms.  For
      the syntax of a particular command form, please consult the
      documentation.

(EAGLE) >
```

☐ Enter the IP parameters.

- Local IP address
  On delivery, the device has the local IP address 0.0.0.0.
- Netmask
  If your network has been divided up into subnetworks, and if these are identified with a netmask, then the netmask is to be entered here.
  The default setting of the netmask is 0.0.0.0.
- IP address of the gateway
  This entry is only required if the device and the management station or TFTP server are located in different subnetworks (see page 34 “Example of how the network mask is used”).
  Enter the IP address of the gateway between the subnetwork with the device and the path to the management station.
  The default setting of the IP address is 0.0.0.0.

☐ Save the configuration entered using
`copy config running-config nvm`.

`enable`	Switch to the privileged EXEC mode.
`network protocol none`	Deactivate DHCP.
`network parms 10.0.1.23 255.255.255.0`	Assign the device the IP address 10.0.1.23 and the netmask 255.255.255.0. You have the option of also assigning a gateway address.
`copy config running-config nvm`	Save the current configuration to the non-volatile memory.

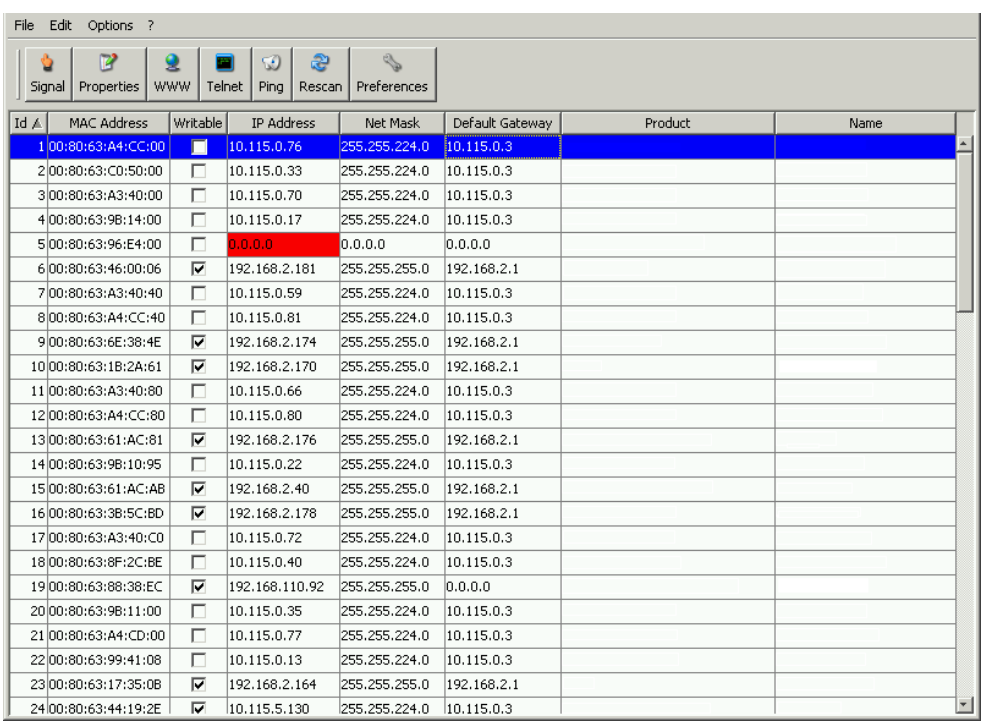
After entering the IP parameters, you can easily configure the device via the Web-based interface (see the “GUI” (Graphical User Interface / Web-based Interface) reference manual).

2.3 Entering the IP Parameters via HiDiscovery

The HiDiscovery protocol enables you to assign IP parameters to the device via the Ethernet.
You can easily configure other parameters via the Web-based interface (see the “GUI” (Graphical User Interface / Web-based Interface) reference manual).

Install the HiDiscovery software on your PC. The software is on the CD supplied with the device.

☐ To install it, you start the installation program on the CD.
☐ Start the HiDiscovery program.



Id	MAC Address	Writable	IP Address	Net Mask	Default Gateway	Product	Name
1	00:80:63:A4:CC:00	☐	10.115.0.76	255.255.224.0	10.115.0.3		
2	00:80:63:C0:50:00	☐	10.115.0.33	255.255.224.0	10.115.0.3		
3	00:80:63:A3:40:00	☐	10.115.0.70	255.255.224.0	10.115.0.3		
4	00:80:63:9B:14:00	☐	10.115.0.17	255.255.224.0	10.115.0.3		
5	00:80:63:96:E4:00	☐	0.0.0.0	0.0.0.0	0.0.0.0		
6	00:80:63:46:00:06	☑	192.168.2.181	255.255.255.0	192.168.2.1		
7	00:80:63:A3:40:40	☐	10.115.0.59	255.255.224.0	10.115.0.3		
8	00:80:63:A4:CC:40	☐	10.115.0.81	255.255.224.0	10.115.0.3		
9	00:80:63:6E:38:4E	☑	192.168.2.174	255.255.255.0	192.168.2.1		
10	00:80:63:1B:2A:61	☑	192.168.2.170	255.255.255.0	192.168.2.1		
11	00:80:63:A3:40:80	☐	10.115.0.66	255.255.224.0	10.115.0.3		
12	00:80:63:A4:CC:80	☐	10.115.0.80	255.255.224.0	10.115.0.3		
13	00:80:63:61:AC:81	☑	192.168.2.176	255.255.255.0	192.168.2.1		
14	00:80:63:9B:10:95	☐	10.115.0.22	255.255.224.0	10.115.0.3		
15	00:80:63:61:AC:AB	☑	192.168.2.40	255.255.255.0	192.168.2.1		
16	00:80:63:3B:5C:BD	☑	192.168.2.178	255.255.255.0	192.168.2.1		
17	00:80:63:A3:40:C0	☐	10.115.0.72	255.255.224.0	10.115.0.3		
18	00:80:63:8F:2C:BE	☐	10.115.0.40	255.255.224.0	10.115.0.3		
19	00:80:63:88:38:EC	☑	192.168.110.92	255.255.255.0	0.0.0.0		
20	00:80:63:9B:11:00	☐	10.115.0.35	255.255.224.0	10.115.0.3		
21	00:80:63:A4:CD:00	☐	10.115.0.77	255.255.224.0	10.115.0.3		
22	00:80:63:99:41:08	☐	10.115.0.13	255.255.224.0	10.115.0.3		
23	00:80:63:17:35:0B	☑	192.168.2.164	255.255.255.0	192.168.2.1		
24	00:80:63:44:19:2E	☑	10.115.5.130	255.255.224.0	10.115.0.3		

Figure 8: HiDiscovery

When HiDiscovery is started, HiDiscovery automatically searches the network for those devices which support the HiDiscovery protocol. HiDiscovery uses the first network interface found for the PC. If your computer has several network cards, you can select the one you desire in the HiDiscovery toolbar.

HiDiscovery displays a line for every device that reacts to the HiDiscovery protocol.

HiDiscovery enables you to identify the devices displayed.

☐ Select a device line.

☐ Click on the signal symbol in the tool bar to set the LEDs for the selected device flashing. To switch off the flashing, click on the symbol again.

☐ By double-clicking a line, you open a window in which you can enter the device name and the IP parameters.

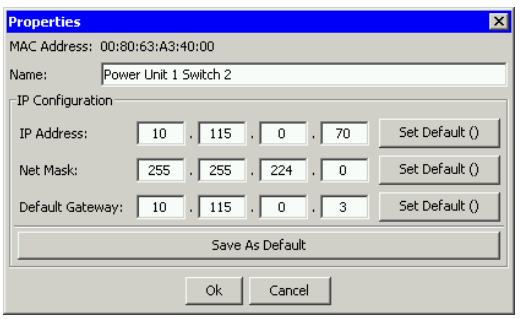


Figure 9: HiDiscovery – assigning IP parameters

Note: When the IP address is entered, the device copies the local configuration settings (see on page 45 “Configuration Management”).

Note: For security reasons, switch off the HiDiscovery function for the device in the Web-based interface, after you have assigned the IP parameters to the device (see on page 43 “Web-based IP Configuration”).

Note: Save the settings so that you will still have the entries after a restart (see on page 45 “Configuration Management”).

2.4 Web-based IP Configuration

In the `Basic Settings:Network` dialog you can assign IP parameters and configure the HiDiscovery access.

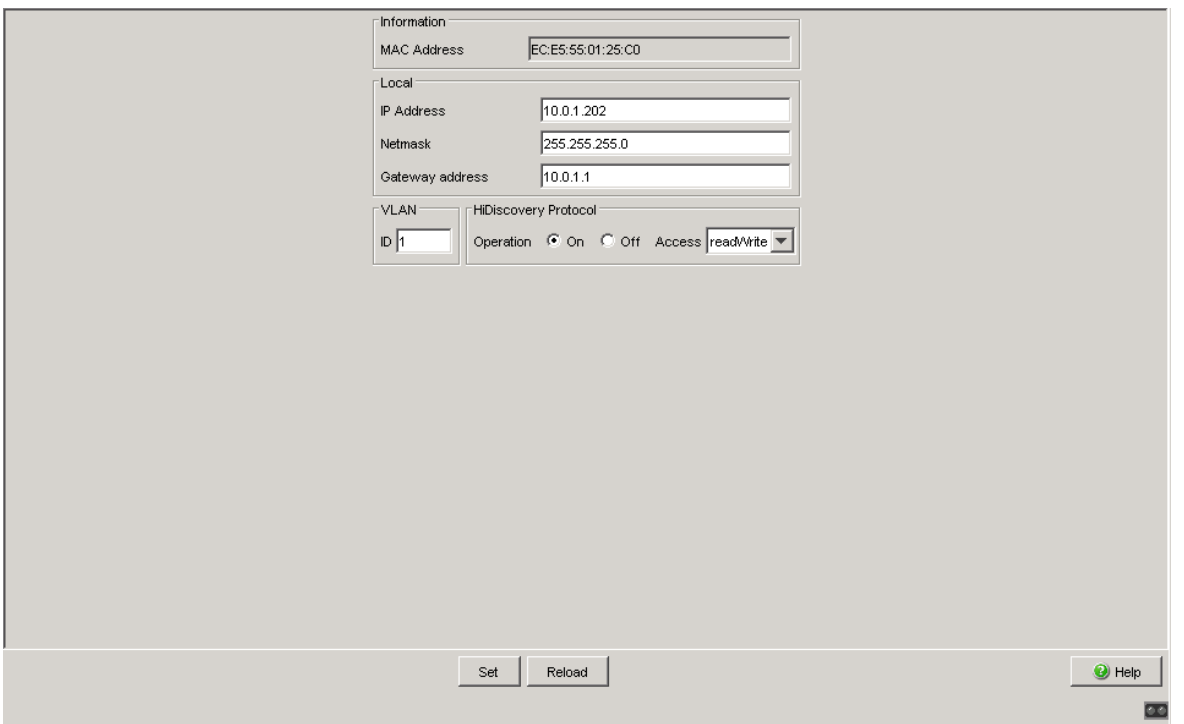


Figure 10: Network parameters dialog

- ☐ The "VLAN" frame enables you to assign a different VLAN to the management CPU of the device.

- ☐ The HiDiscovery protocol allows you to allocate an IP address to the device on the basis of its MAC address. Activate the HiDiscovery protocol if you want to allocate an IP address to the device from your PC with the supplied HiDiscovery software (setting on delivery: "Operation"`on`, "Access"`read-write`).

Note: Save the settings so that you will still have the entries after a restart (see on page 45 “Configuration Management”).

3 Configuration Management

The device saves settings such as the IP parameters and the port configuration in the temporary memory. These settings are lost when you switch off or reboot the device.
The device allows you to do the following:

- Load settings from a non-volatile memory into the temporary memory
- Save settings from the temporary memory in a non-volatile memory

If you change the current configuration (e.g. disable a port), after updating, the tool bar of the graphical user interface displays the symbol . After saving the configuration and updating the tool bar, the symbol disappears.

3.1 Loading settings

Note: Details of times required for a reboot:

- The time required for a cold start is the time taken by the device from the moment power is switched on until it is fully connected and its Management-CPU is fully accessible.
- Depending on the device type and the extent of the configuration settings, a cold start takes at least about 10 seconds.
- Extensive configuration settings will increase the time required for a reboot, especially if they contain a high number of VLANs. In extreme cases, a reboot can take up to about 200 seconds.

During operation, the device allows you to load settings from the following sources:

- the local non-volatile memory
- a file in the connected network (setting on delivery)
- the firmware (restoration of the configuration on delivery).

Note: When loading a configuration, hold off any accesses to the device until it has loaded the configuration file and applied the new configuration settings. Depending on the device type and the extent of the configuration settings, this process can take between 10 and 200 seconds.

Note: Loading a configuration deactivates the ports while the configuration is being set up. Afterwards, the Switch sets the port status according to the new configuration.

3.1.1 Loading from the local non-volatile memory

When loading the configuration data locally, the device loads the configuration data from the local non-volatile memory.

- ☐ Open the `Basic Settings:Load/Save` dialog.
- ☐ Highlight the NVM line to be loaded.
- ☐ Click "Activate" to activate the configuration.
- ☐ Click "Load" to load the configuration.

`enable`	Switch to the privileged EXEC mode.
`copy config nvm running-config`	The device loads the configuration data from the local non-volatile memory.

3.1.2 Loading from a file

The device allows you to load the configuration data from a file in the connected network.

- ☐ Select the "Storage Type" in the "Destination" frame:
  - `nvm` for non-volatile memory
  - `ram` for volatile memory.
- ☐ Enter a Profile "Name" to appear in the list.
- ☐ Click "OK".

3.1.3 Resetting the configuration to the state on delivery

The device enables you to:

- reset the current configuration to the state on delivery.
- reset the device to the state on delivery. After the next restart, the IP address is also in the state on delivery.

☐ Click on the blue arrow in the `Basic Settings:Load/Save`dialog and then click "Back to factory defaults...".

`enable`	Switch to the privileged EXEC mode.
`clear factory`	The device clears the configurations.

Resetting the device using System Monitor 1

The device is reset to the factory setting using option 4 of System Monitor 1.

☐ Enter the CLI global command `reboot`. As the device is rebooting press `1` to enter the System Monitor.
☐ Enter `4` (`Manage configurations`).
☐ Enter `1` (`Boot default configurations`).

3.2 Saving settings

When you actuate the "Save" button in `Basic Settings:Load/Save` dialog, the device will save the current configurations in the following places:

- on the device
- On the external memory

3.2.1 Saving locally

The device allows you to save the current configuration data in the local non-volatile memory.

☐ Open the `Basic Settings:Load/Save` dialog.
☐ Click on "Save".
The device stores the current configuration data in the local non-volatile memory.

`enable`	Switch to the privileged EXEC mode.
`copy config running-config nvm`	The device stores the current configuration data in the local non-volatile memory.

3.2.2 Saving on a PC

The device allows you to save the current configuration data in XML format on your PC.

- ☐ Highlight the configuration to be saved in the `Basic Settings:Load/Save` dialog
- ☐ Actuate the blue down arrow to display more file management options.
- ☐ Click on "Export...".
- ☐ Enter the `URL` for the location where the file is to be saved. The device allows you to enter the URL manually. Use the "..." button to assist you in finding the location where the file is to be stored.
- ☐ Click on "OK" to save the file.

4 Loading Software Updates

Hirschmann is continually working to improve and develop our software. You should regularly check whether there is a new version of the software that provides you with additional benefits. You will find software information and downloads on the product pages of the Hirschmann website.

Checking the installed Software Release

☐ Open the `Basic Settings:Software` dialog.

This dialog indicates the Release Number of the software installed in the device.

`enable`	Switch to the privileged EXEC mode.
`show system info`	Show system information.

Loading the software

The device gives you the following options for loading the software:

- via a file selection dialog from your PC.

Note: The existing configuration of the device is still there after the new software is installed.

4.1 Loading the Software via File Selection

For a software update via a file selection window, the device software must be on a data carrier that you can access from your PC.

- ☐ Open the `Basic Settings:Software` dialog.
- ☐ Click on ".." in the "Software Update" frame.
- ☐ In the "Open" dialog select the file with the suffix `*.bin`, e.g. `HiSecOS-EAGLE-01000.bin`.
- ☐ Click on "Open".
- ☐ Click on "Update" to transfer the software to the device.
  When the file is completely transferred, the device starts updating the device software. If the update was successful, the device displays the message "Successfully firmware update on EAGLE20/30".
- ☐ Restart the device.
  After restarting the device works with the updated software.

4.2 Software update via SFTP/ SCP

The device offers the possibility to upload the new software from your PC via SFTP or SCP onto your device. Therefore you need an SFTP or SCP client, e. g. WinSCP. In order to transfer the software, you perform the following steps:

☐ On your PC, open an SFTP or SCP client, e.g. WinSCP.

☐ Use the SFTP or SCP client to open a connection to the device.

☐ Transfer the file with the ending `*.bin`, e.g. `HiSecOS-EAGLE-01000.bin`, to the `/upload/firmware` directory on the device.
When the file is completely transferred, the device starts updating the device software. If the update was successful, the device creates an `ok` file in directory `/upload/firmware` and deletes the file with the ending `*.bin`.

☐ Restart the device.
After restarting the device works with the updated software.

5 Configuring the Ports

The following port configuration functions are available.

- Switching the port on and off,
- Selecting the operating mode,
- Displaying detected loss of connection

Switching the port on and off

In the state on delivery, every port is switched on. For a higher level of access security, switch off the ports for which you are not making any connection.

☐ Open the `Basic Settings:Port Configuration` dialog.

☐ In the "Port on" column, activate the ports that are connected to another device.

Selecting the operating mode

In the state on delivery, the ports are set to "Automatic Configuration" operating mode.

Note: The active automatic configuration has priority over the manual configuration.

☐ Open the `Basic Settings:Port Configuration` dialog.

☐ If the device connected to this port requires a fixed setting:
- ☐ Select the operating mode (transmission rate, duplex mode) in the "Manual Configuration" column.
- ☐ Deactivate the checkbox in the "Automatic Configuration" column.

6 Assistance in the Protection from Unauthorized Access

The device provides the following functions to help prevent unauthorised accesses.

- Password for SNMP access
- Switching off access to the device via the following services:
  - SSH
  - HTTPS
  - SNMP
- Restricted IP Access
- HiDiscovery-Function can be switched off

6.1 Handling unauthorised accesses

If you want to maximize the protection of the device against unauthorized access in just a few steps, you can perform the following steps on the device as required:

- ☐ Deactivate SNMPv1 and SNMPv2 (per default deactivated) and select a password for SNMPv3 access other than the standard password.
- ☐ Deactivate SSH access (see on page 61 “Access to the device”).
- ☐ Deactivate HiDiscovery access.

Note: Retain at least one option to access the device. Connecting to the device via V.24 serial access is possible, since it cannot be deactivated.

6.2 SNMPv1/v2 Community

6.2.1 Description of SNMPv1/v2

A network management station communicates with the device via the Simple Network Management Protocol (SNMP).
Every SNMP packet contains the IP address of the sending computer and the Community Name with which the sender of the packet wants to access the device MIB.

The device receives the SNMP packet and compares the Community Name of the sending computer with the entries in the device‘s MIB.
If the name has the appropriate access level then the device will allow access for the designated permission level.

In the delivery state, the device is accessible via the password `public` (Read) and `private` (Read and Write) from every computer.

To help protect your device from unwanted access:

☐ First define new names with which you have viewing (Read) and administrative (Read and Write) access to the device from your computer.

☐ Treat these names as confidential, because everyone who knows the name can access the device MIB.

Note: SNMPv1 and SNMPv2 are potentially unsecure, because the device sends the community name as plain text. For this reason, SNMPv1 and SNMPv2 are per default deactivated. Turn on this function when other possibilities are unavailable and you are aware of the consequences.

6.2.2 Entering the SNMPv1/v2 name

- ☐ Open the `Security:Management Access:SNMPv1/v2 Community` dialog.
  This dialog gives you the option of changing the read and write names for the SNMPv1/v2 Community.
  In the "Name" frame, specify the desired name for reading access and for writing access. Users with reading access should neither know nor be able to guess the name for writing access.
- ☐ To enter a new read name double click on the name located in the "Community":"Read":"Name" field.
- ☐ Enter the new read name in the "Name" field.
- ☐ To enter a new read/write name double click on the "Name" field.
- ☐ Enter the new read/write name in the "Name" field.
- ☐ You save the new name by actuating "Set" and then "Reload".
- ☐ Open the `Security:Management Access:Server` dialog.
- ☐ In the "Configuration" frame, select the "SNMPv1 enabled" or "SNMPv2 enabled" checkboxes.

The user accounts set up in the device use the same passwords in the web-based interface, in the Command Line Interface (CLI) and for SNMPv3.

6.3 Access to the device

Switching off access to the device via the following services:
- SSH
- HTTPS
- SNMP

6.3.1 Description of SSH Access

The device's SSH server allows you to configure the device using the Command Line Interface (in-band). You can deactivate the SSH server to help prevent SSH access to the device.
The server is activated in its state on delivery.
After the SSH server has been deactivated, you will no longer be able to access the device via a new SSH connection. If an SSH connection already exists, it is retained.

☐ In the `Security:Management Access:Server` dialog, open the "SSH" tab page.

☐ In the "Operation" frame select the `Off` radio button to disable the server, refusing SSH access.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`ssh server`	Enable SSH function.
`no ssh server`	Disable SSH function.

Note: If a host key is not present, the device generates a DSA and RSA key at startup. After key generation activate the server. The server is available after generating at least 1 key.

Note: The Command Line Interface (out-of-band) and the `Security:Management Access:Server` dialog, "SSH" register, in the Web-based interface allows you to reactivate the SSH server.

6.3.2 Description of HTTPS Access

The web server uses HTTPS to load a Java applet for the web-based interface onto your computer.
The server is activated in its state on delivery.
After deactivating the HTTPS server, you will no longer be able to access the device via a new HTTPS connection. Existing HTTPS connections remain.

☐ In the `Security:Management Access:Server` dialog, open the "HTTPS" tab page.

☐ In the "Operation" frame select the `Off` radio button to disable the server, refusing HTTPS access.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`https server`	Enable HTTPS function.
`no https server`	Disable HTTPS function.

Note: In order to activate the HTTPS server, a certificate must be present. If a certificate is not present at startup the device generates it.

Note: The Command Line Interface (out-of-band) allows you to reactivate the HTTPS server.

6.4 IP Access Restriction

The device allows you to differentiate the management access based on IP address ranges, and to differentiate these based on management services. With this option you have the ablity to granularly set management access rights.

If you only want the device, which is located in a production plant for example, to be managed from the network of the IT department via the Web interface but also want the administrator to be able to access it remotely via SSH, you can achieve this with the "IP Access Restriction" function.

Configure this function using the web-based interface or the CLI. The web-based interface provides you with an easy configuration option. However, to verify that you maintain access to the device use the CLI option with a serial V.24 connection.

In the following example, the IT network has the address range 192.168.1.0/24 and the remote access is from a mobile phone network with the IP address range 109.237.176.0 - 109.237.176.255.

The device is always available for SSH access and the SSH client application already knows the fingerprint of the host key on the device.
See “Preparing access via SSH” on page 170.

Parameter	IT network	Mobil phone network
Network address	192.168.1.0	109.237.176.0
Netmask	24	24
Desired management access	https, snmp	ssh

Table 2: Example parameters for the restricted management access

- ☐ Open the `Security:Management Access:IP Access Restriction` dialog.
- ☐ Leave the existing entry unchanged and use the "Create" button to create a new entry for the IT network.
- ☐ Enter the IP Address Range192.168.1.0/24.
- ☐ Deactivate the SSH service. Leave the HTTPS and SNMP services on.

- ☐ Use the "Create" button to create a new entry for the mobile phone network.
- ☐ Enter the IP Address Range 109.237.176.0/24.
- ☐ Deactivate the HTTPS and SNMP services and leave SSH activated.
- ☐ Verify that you have CLI access to the device via V.24.
- ☐ Deactivate the preset entry. There are no restrictions set with this entry and would cause your subsequent entries to have no effect.
- ☐ Enable the desired port with a check in the "Active" checkbox.
- ☐ Click on "Write" to temporarily save the data.
- ☐ If your current management station is also located in the IT network, you continue to have access to the Web-based interface. Otherwise the device ignores operations via the Web-based interface, and it also rejects a restart of the Web-based interface.
- ☐ Check whether you can access the device from the IT network via https and snmp: Open the Web-based interface of the device in a browser, login on the start screen, and check whether you can read data (as user “user”) or read and write data (as user “admin”).
  Check whether the device rejects connections via ssh.
- ☐ Check whether you can access the device from the mobile phone network via ssh: Open an SSH client, make a connection to the device, login, and check whether you can read or read and write data.
  Check whether the device rejects connections via https and snmp.
- ☐ When you have successfully completed both tests, save the settings in the non-volatile memory. Otherwise check your configuration. If the device rejects access with the Web-based interface, use the CLI of the device to initially deactivate the function via V.24.

`enable`	Switch to the privileged EXEC mode.
`show network management access global`	Display the current function status.
`show network management access rules`	Display the restricted management access rules.
`network management access add 2`	Create an entry for the IT network. Number of next available index- in the example, 2.
`network mangement access modify 2 ip 192.168.1.24`	Set the IP address of the entry for the IT network.
`network management access modify 2 mask 24`	Set the netmask of the entry for the IT network.
`network management access modify 2 ssh disable`	Deactivate SSH for the entry of the IT network.
`network management access add 3`	Create an entry for the mobile phone network. In the example, this is given the ID 3.

`network management access modify 3 ip 109.237.176.24`	Set the IP address of the entry for the mobile phone network.
`network management access modify 3 mask 24`	Set the netmask of the entry for the mobile phone network.
`network management access modify 3 snmp disable`	Deactivate snmp for the entry of the mobile phone network.
`no network management access status 1`	Deactivate the **preset** entry.
network management access status 2	Activates the entry 2.
network management access status 3	Activates the entry 3.
`network management access operation`	Enable operation for RMA.
`show network management access rules`	Display the restricted management access rules.
`copy config running-config nvm`	The device stores the current configuration data in the local non-volatile memory.

6.5 Access Control Lists

In this menu you can enter the settings for the Access Control Lists (ACLs).

The device uses access control lists to filter data packets or frames coming in at individual or multiple ports or at VLANs. In the respective ACL, you create rules that the device uses to carry out filtering. When such a rule applies to a packet or a frame, the device applies the actions defined in the rule to the packet or frame. Four possible actions are available here:

- Allow ("permit")
- Discard ("deny")
- Redirect to a certain port (through the "Redirection Port" entry)
- Mirror (through the "Mirror Port" entry)

You can filter incoming data according to the following criteria:

- Source or destination address of a frame (MAC)
- Source or destination address of a data packet (IPv4)
- Type of the transmitting protocol (MAC/IPv4)
- Source or destination port of a data packet (IPv4)
- Service class of a frame (MAC)
- Membership of a specific VLAN (MAC)
- Classification according to DSCP (IPv4)
- Classification according to ToS (IPv4)

The assignment of IP ACLs and MAC ACLs to ports and VLANs results in four different types of ACLs:

- IP ACLs for VLANs
- IP ACLs for ports
- MAC ACLs for VLANs
- MAC ACLs for ports

Within an ACL type, the device processes the rules in order, with the index of the respective role determining the corresponding order. You can thus define the priority of a rule using the index or sequence number when you assign an ACL to a port or VLAN. The following generally applies: the lower the sequence number, the higher the priority. When processing the rules, the device processes the rule with the higher priority first.

When several ACL types contain rules that apply to a data packet, the priority of the ACL type decides which rule the device applies first. Note that the priority of an ACL type is independent of the index or sequence number of a rule. It is generally true that IP ACLs have a higher priority than MAC ACLs. The device thus gives preference to IP ACLs over MAC ACLs.

You can create up to 128 MAC ACLs and up to 128 IP ACLs. Each ACL can contain up to 239 rules, with the device allowing a maximum number of 956 rules regardless of the ACL type. This corresponds to four completely filled ACLs with 239 rules each.

You can assign a maximum of 239 rules to a single port, irrespectively of the ACL tpye used.

The assignment of ACLs to single ports corresponds to the maximum number of ACLs you can create. This means you can simultaneously assign a maximum of 128 MAC ACLs and 128 IP ACLs to a single port.

You can assign a maximum of 176 rules to a single VLAN, reguardless of the ACL tpye used.

Assigning ACLs to VLANs is limited to 64 VLANs. This means you can simultaneously assign the ACLs to a maximum of 64 VLANs.

Note: You can assign a single ACL to any number of ports or VLANs.

If you have assigned one or several ACLs to a port or VLAN, the device will process the ACLs corresponding to their priority when traffic comes in on an interface. If none of the rules contained in the ACLs match an incoming data packet, the default “deny” rule will apply. As a result, the device will drop all incoming data packets.

Keep in mind that the default “deny” rule is directly implemented in the device. You cannot edit or change this rule.

The "Access Control Lists" menu contains the following dialogs:

- IPv4 Name
- IPv4 Rule
- MAC Name
- MAC Rule
- Port Assignment
- VLAN Assignment

In these dialogs you can designate the rules for the various ACL types, configure them, and provide them with the required priorities. You also take care of the assignment of the rules to certain ports or VLANs here.

6.5.1 IPv4 Name

This dialog allows you to create, name, activate and deactivate ACLs for filtering of IPv4 data packets.

Proceed as follows to create and save a new IP ACL:

- ☐ Click the "Create" button.
  This will add a new entry to the table. The device will automatically assign a sequential index number to the newly created entry.
- ☐ Click on the "Name" field and enter a meaningful name. You are allowed to enter 1 to 31 alphanumeric characters. The default name is `default`.
- ☐ Click the "Active" field of this entry to activate the IP ACL.
- ☐ Click "Set" to transfer the IP ACL to the volatile memory of the device.
- ☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

☐ Actuate the "Reload" button if you want to update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove an ACL entry from the list, select the entry and click the "Remove" button.

6.5.2 IPv4 Rule

In this dialog you can configure the individual rules for IPv4 ACLs. The rules created here only relate to IP data packets.

Proceed as follows to create and edit a new IPv4 rule:

☐ Click the "Create" button. Select an ACL and assign an index number to the rule that you want to configure. Keep in mind that the index number determines the priority of the rule.
☐ Confirm the current selection by clicking "OK". The device will add this selection to the table.
☐ For each rule created, edit the individual parameters in the table.
☐ Click the "Active" field of an entry to activate the respective rule.
☐ Click "Set" to transfer the rule to the volatile memory of the device.
☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

Note: You can use wildcards with the "Source IP Address" and "Destination IP Address" parameters. If you enter, for example, `192.168.?.?`, the device will admit all addresses the first two octets of which start with `192.168.`.

Note: Editing the "Source TCP/UDP Port" and "Destination TCP/UDP Port" parameters requires you to set either of the values `tcp` or `udp` in the "Protocol" field beforehand.

Note: Configuring a port with the "Redirection Port" or "Mirror Port" parameters requires you to set the "Action" parameter to `permit` beforehand.

☐ Click the "Reload" button in order to
- update the table with changes to an existing ACL name previously made in the "IPv4 Name" dialog;
- update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove a rule from the list, select the rule and click the "Remove" button.

6.5.3 MAC Name

This dialog allows you to create, name, activate and deactivate ACLs for filtering MAC frames.

Proceed as follows to create and save a new MAC ACL:

☐ Click the "Create" button.
This will add a new entry to the table. The device will automatically assign a sequential index number to the newly created entry.

☐ Click on the "Name" field and enter a meaningful name. You are allowed to enter 1 to 31 alphanumeric characters. The default name is `default`.

- ☐ Click the "Active" field of this entry to activate the MAC ACL.
- ☐ Click "Set" to temporarily save the MAC ACL in the configuration.
- ☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

☐ Actuate the "Reload" button if you want to update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove an ACL entry from the list, select the entry and click the "Remove" button.

6.5.4 MAC Rule

In this dialog you can configure the individual rules for MAC ACLs. The rules created here only relate to MAC frames.

Proceed as follows to create and edit a new MAC rule:

- ☐ Click the "Create" button. Select an ACL and assign an index number to the rule that you want to configure. Keep in mind that the index number determines the priority of the rule.
- ☐ Confirm the current selection by clicking "OK". The device will add this selection to the table.
- ☐ For each rule created, edit the individual parameters in the table.
- ☐ Click the "Active" field of an entry to activate the respective rule.
- ☐ Click "Set" to transfer the rule to the volatile memory of the device.
- ☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

Note: You can use wildcards with the "Source MAC Address" and "Destination MAC Address" parameters. Both parameters allow you to enter address filters which, e. g., may have the form `FF:??:??:??:??:??` or `??:??:??:??:00:01`. Be sure to use capital letters here.

Note: Configuring a port with the "Redirection Port" or "Mirror Port" parameters requires you to set the "Action" parameter to `permit` beforehand.

☐ Click the "Reload" button in order to
- ▶ update the table with changes to an existing ACL name previously made in the "MAC Name" dialog;
- ▶ update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove a rule from the list, select the rule and click the "Remove" button.

6.5.5 Port Assignment

With this dialog you can assign the ACLs to specific ports.

Proceed as follows to edit an assignment:

- ☐ Click the "Assign" button. Select the desired port and configure the parameters "Sequence", "Direction" and "Rule Index". Be sure to set the "Direction "parameter to `inbound` .
- ☐ Confirm the current selection by clicking "OK". The device will add this selection to the table.
- ☐ Click "Set" to transfer the rule to the volatile memory of the device.
- ☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

☐ Actuate the "Reload" button if you want to update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove an ACL entry from the list, select the entry and click the "Remove" button.

6.5.6 VLAN Assignment

This dialog allows you to assign the ACLS to individual VLANs.

Proceed as follows to edit an assignment:

- ☐ Click the "Assign" button. Select the desired port and configure the parameters "Sequence", "Direction" and "Rule Index". Be sure to set the "Direction "parameter to `inbound` .
- ☐ Confirm the current selection by clicking "OK". The device will add this selection to the table.
- ☐ Click "Set" to transfer the rule to the volatile memory of the device.
- ☐ To permanently save the changes, choose the active device configuration in the `Basic Settings:Load/Save` dialog and click "Save".

☐ Actuate the "Reload" button if you want to update the table with values edited outside of the web interface (e. g. via the CLI).

☐ In order to remove an ACL entry from the list, select the entry and click the "Remove" button.

6.6 HiDiscovery Access

6.6.1 Description of the HiDiscovery Protocol

The HiDiscovery protocol allows you to allocate an IP address to the device on the basis of its MAC address (see on page 40 “Entering the IP Parameters via HiDiscovery”). HiDiscovery is a Layer 2 protocol.

Note: Restrict the HiDiscovery function for the device or disable it after you have assigned the IP parameters to the device.

6.6.2 Enabling/disabling the HiDiscovery Function

☐ Open the `Basic Settings:Network` dialog.

☐ In the "HiDiscovery Protocol" frame, disable the HiDiscovery function or restrict the access to `readOnly`.

`enable`	Switch to the privileged EXEC mode.
`no network hidiscovery operation`	Disable the HiDiscovery function.
`network hidiscovery mode read-only`	Enable HiDiscovery function with “read-only” access
`network hidiscovery mode read-write`	Enable HiDiscovery function with “read-write” access

6.7 Session Timeouts

The following session timeouts are available on the device. Open the `Security:Management Access` dialog.

6.7.1 CLI and Web session

Use the `Security Management Access:Web` dialog to configure how long a Web Interface session remains open.
Using the `Security:Management Access:CLI` dialog you configure what name appears in the CLI prompt. You also configure how long a CLI session remains open.

Use the login banner to provide a message for device users.

- ☐ In the `Security:Management Access:CLI` dialog, open the "Global" tab page.
- ☐ Enter the name that you want to appear for a prompt in the "Login Prompt" field in the "Configuration" frame.
- ☐ Enter how long a CLI session remains open in the "V.24 Timeout [min]" field in the "Configuration" frame.
- ☐ In the `Security:Management Access:CLI` dialog, open the "Login Banner" tab page.
- ☐ Enable this feature in the "Operation" frame.
- ☐ Enter the text you want to appear on the device.

`enable`	Switch to the privileged EXEC mode.
`cli prompt name`	Change the system prompt.
`cli banner operation`	Enable or disable the CLI banner.
`cli banner text`	Edit the text to appear in the CLI login banner.

Note: The banner appears in:
- SSH Sessions, after user login,
- Console(V.24) Sessions, before user login.

With the login banner feature enabled, the user configured banner text replaces the default banner.

6.8 Pre-login Banner

Open the `Security:Pre-login Banner` dialog.

6.8.1 Banner Text

Use this frame to edit text that will appear before the user logs into the device.

- ☐ Open the `Security:Pre-login Banner` dialog.
- ☐ Edit the text that you want to appear before a user logs into the device in the "Banner Text" frame.
- ☐ The device provides you with a character count down below the text box. You use this feature to keep track of the text length. You are allowed a total of 512 charactors.
- ☐ Enable this feature in the "Operation" frame.

7 Controlling the Data Traffic

This chapter describes the main task of a firewall. A firewall checks the data packets to be forwarded in accordance with defined rules. Data packets to which the rules apply are either forwarded by a firewall or blocked. When data packets do not correspond to any of the rules, the firewall blocks the packets.

Routing ports to which no rules are assigned allow all packets to pass. As soon as a rule is assigned, the assigned rules are processed first. After that, the configured standard action of the firewall takes effect.

The device provides the following functions for controlling the data traffic:

- Checking the contents and states of data packets (packet filter)
- NAT - Network Address Translation
- Service request control (Denial of Service, DoS)

The firewall observes and monitors the data traffic. The firewall takes the results of the observation and the monitoring and combines them with the rules for the network security to create what is known as a status table. Based on this status table, the firewall decides whether to accept, drop or reject data.

7.1 Packet Filter

7.1.1 Description of the Packet Filter Function

The packet filter allows you filter 2 types of data traffic. The filtering naturally includes checking and evaluation of the data traffic. The device contains a stateful firewall. A stateful firewall tracks the state of the connections transversing it. The firewall filters both the contents and the status of the conveyed data packets. For each type, you have different criteria that you compile into individual rules as required.

In case of filtering for the content of a packet, the firewall checks the following criteria:

- IP header (source address, target address, protocol)
- TCP/UDP header (source port, target port)
- Ethernet header (source MAC address)

You can configure the corresponding values in the table of the `Packet Filters:Rule` dialog.

When filtering according to the status of a packet, the firewall checks the criteria, which you can optionally configure in the "Parameter" field of the `Packet Filters:Rule` dialog.

When you create a new rule in this dialog using the "Create" button, the "Parameter" field initially displays the initial setting `none`. This causes filtering according to the status or the Ethernet header of a packet.

In order to activate optional, status or content filter criteria, you can enter different parameters, which each have the form key=<value>. Which keys are valid depends in part on the protocol of the rule. The keys `mac=<value>` and `state=<value>` apply everywhere and are independent of the protocol. The keys `type=<you>` and `code=<value>` are permitted only for the ICMP protocol; the key `flags=<value>` is only permitted for the TCP protocol.

In the table below, you will find several examples for entries in the "Parameter" field and their effect on filtering. You have the option to enter several keys separated by commas. You can also enter several values separated by dashes. In addition, you can also enter different keys with several values in each case.

Entry	Meaning
mac=de:ad:de:ad:be:ef	This rule only applies to packets with the source MAC address de:ad:de:ad:be:ef.
state=new	This rule only applies to packets coming from a new connection.
state=est	This rule only applies to packets coming from a connection that already exists.
state=new|est	This rule only applies to packets coming from a new connection or a connection that already exists.
type=5	This rule only applies to packets with ICMP type 5.
flags=syn	This rule only applies to packets for which the SYN flag is set.
state=new|rel,flags=rst	This rule applies to all packets that come from new or relative connections and that have the RST flag set.

Table 3: Possible entries in the Parameter field

You can find more information on valid entries in the "Parameter" field in the document Graphical User Interface (GUI) Reference Manual Industrial ETHERNET Firewall (EAGLE20/30).

Since the firewall enables simultaneous filtering according to content and status of data packets, you can compile any combinations of both types of filtering into individual rules. The packet filter allows you to configure up to 2048 individual rules.

Upon receipt of a data packet to be routed, the device generally processes the rules one after another until the first rule that applies to the packet. The rules that follow are ignored.

In order to remove an individual rule, first mark it by clicking the corresponding line and press the "Delete" button.

When none of the rules configured by you applies to a data packet or if you have not configured individual rules, the packet filter applies a standard rule. Three possible standard rules are available here:

Rule	Operation
accept	The device forwards the data packet in accordance with the address information.
drop	The device deletes the data packet without informing the sender.
reject	The device deletes the data packet and informs the sender.

Table 4: Handling filtered data packets

Note: In the state on delivery, the device applies the `drop` rule. You can change this setting in the "Default Policy" field of the `Packet Filters:Global` dialog.

The packet filter adheres to a two-level concept for activating newly configured or changed rules: If you click the "Set" button on the lower edge of the menu, the rules listed in the table are initially saved without activation taking place. Only after the "Commit Changes" button in the `Network Security:Packet Filters:Global` dialog is pressed are the rules transferred to the device and applied.

When you have configured and activated the status-dependent filter criteria, you can have the corresponding effects displayed in the status table. You can find this table with the name “Firewall state (connection tracking) table” on the bottom of the `Diagnosis:Report:System Information` dialog. Based on the entries listed there, you can check which connections are currently established or make sure that the data packets permitted by you actually pass through the firewall, for example.

Note: To delete the status table, click the “Delete Firewall Table” button in the `Basic Settings:Restart` dialog.

7.1.2 Application Example for Packet Filter

The figure shows a typical application case:
A production controller wants to request data from a production robot. The production robot is located in a production cell which a firewall keeps separate from the company network. The firewall is to help prevent data traffic between the production cell and the rest of the company network. Only the data traffic between the robot and the production controller's PC is allowed to flow freely.

The following is known:

Parameter	Robot	Firewall	PC
IP Address Port 1		10.0.1.201	
IP Address Port 4		10.0.2.1	
IP Address	10.0.1.5		10.0.2.17
Gateway	10.0.1.201		10.0.2.1

Prerequisites for further configuration:
- The firewall is in router mode.
- The IP parameters of the Firewall router interface are configured.
- The devices in the internal network have the IP address of port 1 of the firewall as their gateway.
- The gateway and the IP address of the PC and the robot are configured.

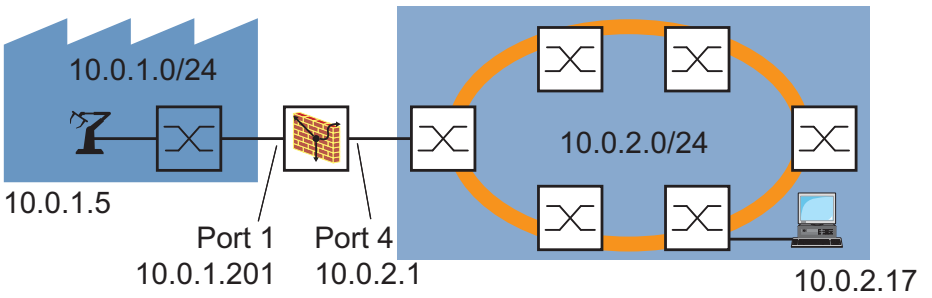


Figure 11: Application example for packet filter

☐ Enter the filter data for incoming IP packets.

☐ Open the `Network Security:Packet Filters:Rules` dialog.
In the state of delivery, the interface assignment table is empty. The default drop policy applies after assigning a rule to an interface. For this reason, the device initially allows traffic to transverse the firewall unrestricted. Creating a rule and assigning it to the relevant interface changes this condition..

☐ Click “Create”.
You thus add a new entry to the table.

☐ Enter the filter data:
Source Address: `10.0.2.17` or `10.0.2.17/32`
Source Port: `any`
Destination Address: `10.0.1.5` or `10.0.1.5/32`
Destination Port: `any`
Protocol: `any`
Action: `accept`

☐ Click the "Active" field of this entry to activate the entry.

☐ Click "Set" to temporarily save the entry in the configuration.

☐ Assign the rule to one or more interfaces for the purpose of activation.

☐ Open the `Network Security:Packet Filters:Global` dialog. There you click the "Apply Changes" button to update the firewall and activate the firewall rules.

The device allows you to selectively check incoming IP packets for specific ICMP traffic criteria. To activate this function for an existing or new packet filter, you proceed as follows:

- ☐ Open the `Network Security:Packet Filters:Rules` dialog.
- ☐ As required, add a new entry to the table and enter the filter data as described in the previous table (see section “Application Example for Packet Filter”).
- ☐ In the "Protocol" selection field, choose the entry `icmp`.
- ☐ In the “Parameter” input field, enter the ICMP type and code: `type=3,code=1` means:
  - Destination unreachable (ICMP type 3)
  - Host unreachable (ICMP code 1)

  The values behind `type` and `code` are 1- to 3-digit decimal values. Entering an ICMP code is optional. You will find the possible values for the ICMP types and codes in the “ICMP types and codes” table in the “Grafische Benutzeroberfläche (GUI)” reference manual.
- ☐ Click "Set" to temporarily save the entry in the configuration.

☐ Enter the filter data for outgoing IP packets.

- ☐ Open the `Network Security:Packet Filters:Rules` dialog.
- ☐ Add a new entry to the table if required.
- ☐ Select the entry.
- ☐ Enter the filter data for `drop everything`:
  Description: `drop everything`
  Source Address: `any`
  Source Port: `any`
  Destination Address: `any`
  Destination Port: `any`
  Protocol: `any`
  Action: `drop`
  Log: `disable`
- ☐ Click the "Active" field of this entry to activate the entry.

- ☐ Click "Create".
  You thus add a new entry to the table.
- ☐ Select the entry.
- ☐ Enter the filter data:
  Source Address: `10.0.1.5/32`
  Source Port: `any`
  Destination Address: `10.0.2.17/32`
  Destination Port: `any`
  Protocol: `any`
  Action: `accept`
- ☐ Click the "Active" field of this entry to activate the entry.
- ☐ Click "Set" to temporarily save the entry in the configuration.
- ☐ In the `Network Security:Packet Filters:Assignment` dialog, to assign the rules to an interface click on "Assign". Select the port to which you want these rules assigned from the "Port" drop down menu. For the "Direction" parameter, select the value `egress` to activate this rule for outgoing data traffic. Select the `filter data` rule from the "Rule Index" drop down menu. Then repeat this procedure for the `drop everything` rule.
- ☐ In the "Priority" field of the rule named `filter data` enter 1.
- ☐ In the "Priority" field of the rule named `drop everything` enter 2.
- ☐ To activate this entries, click on the "Active" fields.

☐ Save the settings in the non-volatile memory.

- ☐ Open the `Basic Settings:Load/Save` dialog.
- ☐ Click on “Save” to permanently save the data.

7.2 NAT – Network Address Translation

The Network Address Translation (NAT) protocol describes a procedure for automatically and transparently changing IP address information in data packets while still transmitting the data packets to their precise destination. NAT is used when you do not want IP addresses of an internal network to be visible from outside. The reasons for this can include, for example:

- Keeping the structure of the internal network hidden from the outside world.
- Keeping private IP addresses hidden.
- Using IP addresses multiple times – by forming identical production cells, for example.

Depending on your reason for using NAT, it offers you various procedures for using the IP address information. In the following sections, you will find additional information on this process.

7.2.1 IP Masquerading

You use IP Masquerading to hide the internal network structure from outside, concealing it behind a mask, so to speak.

With IP Masquerading, the firewall replaces the source IP address of a data packet from the internal network with the external IP address of the firewall. To identify the different internal IP addresses, NAT adds the logical port number of the connection to the address information. Adding the port information also gave the IP Masquerading the name “Network Address Port Translation” (NAPT).

By converting the IP addresses using port information, devices can set up communication connections to the outside from the internal network. However, as devices in the external network only know the external IP address of the firewall, they are unable to set up a communication connection to a device in the internal network.

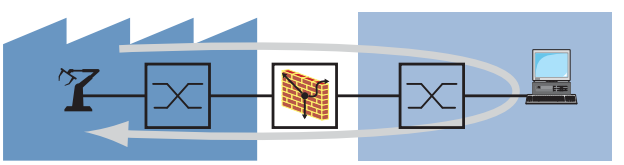


Figure 12: Setting up a communication connection with IP Masquerading

7.2.2 1:1 NAT

You use 1:1 NAT when you are setting up identical production cells with the same IP addresses and want to connect them with the external network. The firewall then allocates to the devices in the internal network a different IP address in the external network.

With 1:1 NAT, the firewall replaces the source IP address of a data packet from the internal network with an IP address of the external network.

Through the 1:1 conversion of the IP addresses, devices can set up communication connections to the outside from the internal network, and devices in the external network can set up communication connections to a device in the internal network.
This is why 1:1 NAT is also called bi-directional NAT.

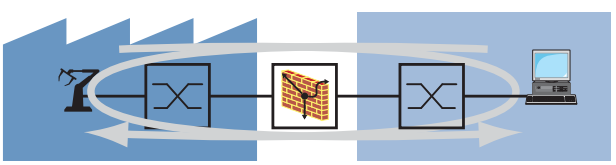


Figure 13: Setting up a communication connection with 1:1 NAT

Note: 1:1 NAT only changes IP addresses in the IP header of the packets. For FTP, the device provides an Application Layer Gateway.

Note: With 1:1 NAT the firewall responds to ARP requests from the external network to addresses which it maps from the internal network. This is also the case when no device with the IP address exists in the internal network. Therefore, in the external network, only allocate to devices IP addresses located outside the area which 1:1 NAT maps from the internal network to the external network.

Double NAT

You use Double NAT, also known as Twice NAT, if you want the devices in the internal network to communicate with the devices in the external network as if the devices in the external network were in the internal network, and vice versa.

In the process, the firewall allocates

- to the devices in the internal network a different IP address in the external network (1:1 NAT function) and
- to the devices in the external network a different IP address in the internal network (inverse 1:1 NAT function).

With double NAT, for a data packet from the internal network, the firewall replaces

- the source IP address with an IP address from the external network and
- the destination IP address with an IP address from the external network.

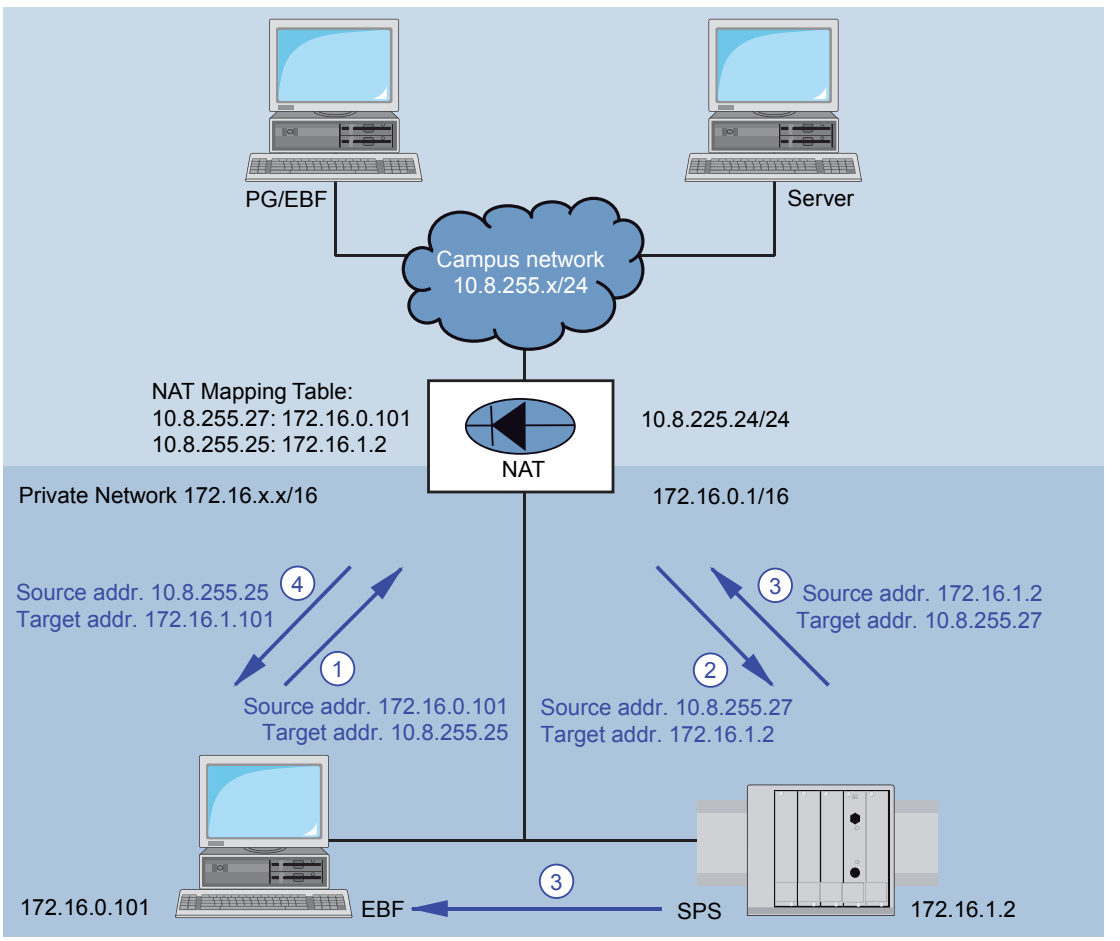


Figure 14: Exchanging external and internal IP addresses for a campus network

This graphic makes clear how Double NAT works: It shows the addresses through which the devices communicate with each other and which addresses are manipulated by the router.

The computer sends a request packet to the PLC. This contains the source address `172.16.0.101` and the destination address `10.8.255.25`. The NAT router (in this case the Eagle-R) replaces both addresses. At the PLC, the same data packet arrives with the source address `10.8.255.27` and the destination address `172.16.1.2` . The PLC then sends an answer packet containing the source address `172.16.1.2` and the destination address `10.8.255.27`. This answer packet in turn arrives at the computer with the source address `10.8.255.25` and the destination address `172.16.1.101`.

During sending and receiving, the NAT router replaced the actual source and destination addresses with virtual addresses in both the request packet and the answer packet. Thus the computer and PLC have communicated with each other without noticing that the communication partner is in another network.

☐ For a specific implementation of the example named above, you would enter the following values in the `Network Security:Double NAT:Rules` dialog:
Local Internal IP Address: `172.16.0.101`
Local External IP Address: `10.8.255.27`
Remote Internal IP Address: `172.16.1.2`
Remote External IP Address: `10.8.255.25`

With this sample configuration, the ingress interface would be at `172.16.0.0/24`, the egress interface at `10.0.16.1/24`.

7.2.3 Port forwarding

You use port forwarding when you want to hide the internal network structure from the outside, but want to allow a communication connection to be set up from the outside in.

With port forwarding, one or more external devices set up a communication connection to the internal network. In doing so, an external device addresses data packets to a specific port with the external IP address of the firewall. Data packets with a permitted source IP address that the firewall receives at this port are forwarded by the firewall to the port of the internal device entered in the NAT table. Hence the name Port Forwarding. As a dedicated destination is addressed in this case, this procedure is also known as Destination NAT.

By converting the IP addresses and the port information using the incoming port addressing, devices can set up network communication connections to the inside from the external network.

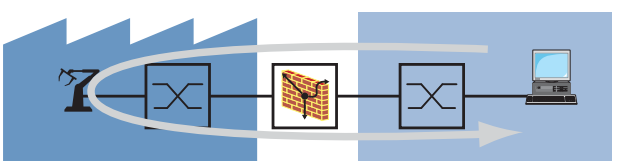


Figure 15: Setting up a communication connection with Port Forwarding

A typical application in the industrial sector is port 5631 for the remote maintenance of a PC in a production cell.

7.2.4 NAT Application Examples

Connecting a production cell with the company network via 1:1 NAT

You have multiple identical production cells and want to connect them with your company network. As even the IP addresses used in the production cells are identical, you convert the IP addresses using the 1:1 NAT function.
The following is known:

Parameter	IP Parameter Firewall 1	IP Parameter Firewall 2
Int. network (production cell, e.g. port 1)	10.0.1.193/28	10.0.2.1/28
Ext. network (company network, e.g. port 4)	10.0.1.193/28	10.0.2.17/28

Prerequisites for further configuration:

- The firewall is in router mode.
- The IP parameters of the router interface are configured.
- The gateway and the IP address of the devices in production cells are configured.
- The devices in the production cells use the IP address of port 1 of the firewall as their gateway.

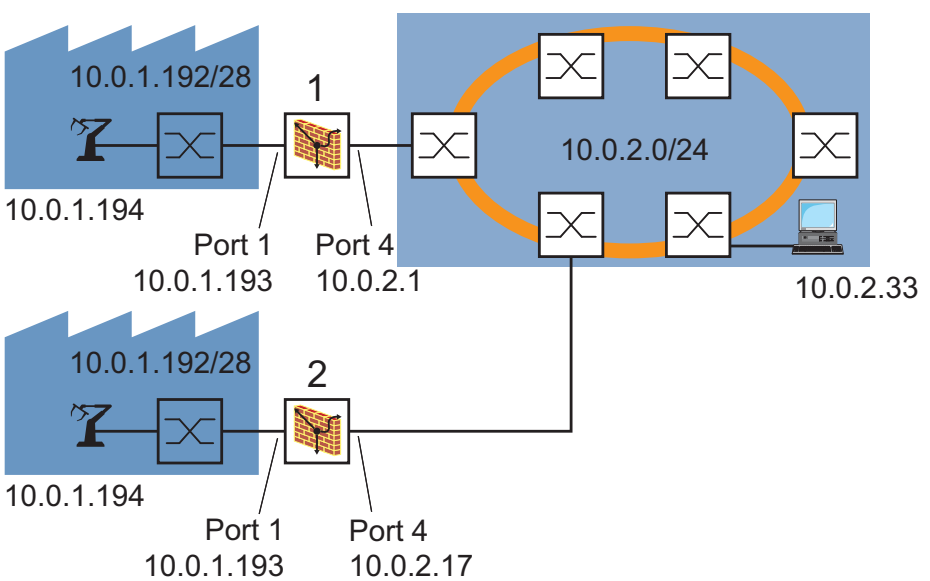


Figure 16: Connecting one of multiple identical production cells with the company network via 1:1 NAT

☐ First you configure firewall number 1.
Enter the parameters for converting the IP addresses.

☐ Open the `Network Security:1:1NAT:Rules` dialog.
☐ Click "Create".
You thus add a new entry to the table.
☐ Enter the parameters for converting the IP addresses.
Destination Address: `10.0.1.193`
New Destination Address: `10.0.1.192/28`
☐ For the parameter "Ingress Interface" and "Egress Interface", select the ports previously defined under `Routing:Interfaces:Configuration` to which you want to assign this rule. Under `Routing:Interfaces:Configuration`, make sure that you place a checkmark next to "Proxy ARP" for the "Ingress Interface".

Note: In accordance with the example above, the "Ingress Interface" is at 10.0.2.0/24 and the "Egress Interface" at 10.0.1.192/28.

☐ Click "Set and Back" to temporarily save the entry in the configuration.
☐ Click the "Active" field of this entry to activate the entry.

☐ Save the settings in the non-volatile memory.

☐ Open the `Basic Settings:Load/Save` dialog.
☐ Click on “Save” to permanently save the data.

☐ To configure firewall 2, follow the same steps as for the configuration of firewall 1. Under "Destination Address", enter the value `10.0.2.16/28`. Otherwise use the same values as for firewall 1.

Connecting 2 Devices via Double NAT

For test purposes, you want to connect a work station in your company network with a robot in a production cell. As the test set-up requires the two devices to be logically located in the same network, you convert the IP addresses using the double NAT function.

The following is known:

Parameter	Robot	Work station
IP address in the production network (internal)	10.0.1.194	10.0.1.195[a]
IP address in the company network (external)	10.0.2.194[a]	10.0.2.195

Table 5: the IP addresses of the test devices
a: This IP address is created using NAT

Prerequisites for further configuration:

- The firewall is in router mode.
- The IP parameters of the router interface are configured.
- The IP addresses of the devices are configured.

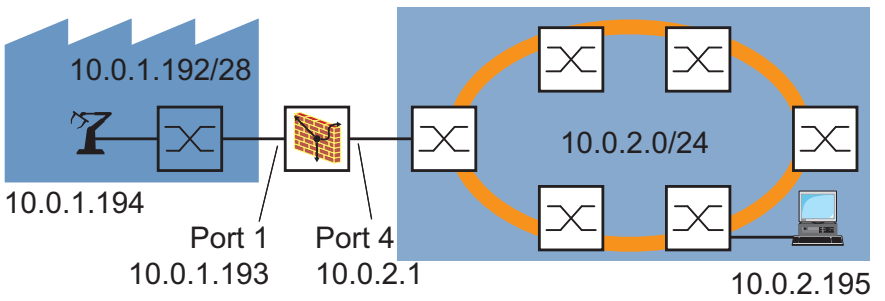


Figure 17: Connecting 2 Devices via Double NAT

☐ Enter the parameters for converting the IP addresses.

☐ Open the `Network Security:Double NAT:Rules` dialog.
☐ Click "Create".
You thus add a new entry to the table.
☐ Enter the parameters for converting the IP address of the robot:
Local Internal IP Address: `10.0.1.194`
Local External IP Address: `10.0.2.194`
Remote Internal IP Address: `10.0.2.195`
Remote External IP Address: `10.0.1.195`

- ☐ Click "Set and Back" to temporarily save the entry in the configuration.
- ☐ Click the "Active" field of this entry to activate the entry.
- ☐ Click "Set" to temporarily save the entries in the configuration.
- ☐ In the `Network Security:Double NAT:Assignment` dialog, click the "Assign" button.
  In the window that now appears, select the port to which you want to assign this rule. For "Direction", select the value `both` to activate this rule for incoming and outgoing data traffic.

☐ Save the settings in the non-volatile memory.

- ☐ Open the `Basic Settings:Load/Save` dialog.
- ☐ Click on "Save" to permanently save the data.

Managing a switch in a production cell from a PC outside the production cell (port forwarding)

You have used a firewall to connect with your company network a production cell with its own IP addresses which should not be visible in the company network. You configure the port forwarding function so that an administrator in the company network can manage a switch within the production cell.
The following is known:

Parameter	Switch	Firewall	PC
IP Address Port 1		10.0.1.201	
IP Address Port 4		10.0.2.1	
IP Address	10.0.1.193		10.0.2.17
Gateway	10.0.1.201		10.0.2.1

Prerequisites for further configuration:

- The firewall is in router mode.
- The IP parameters of the router interface are configured.
- The gateway and the IP address of the devices in production cells are configured.
- The devices in the production cells use the IP address of port 1 of the firewall as their gateway.

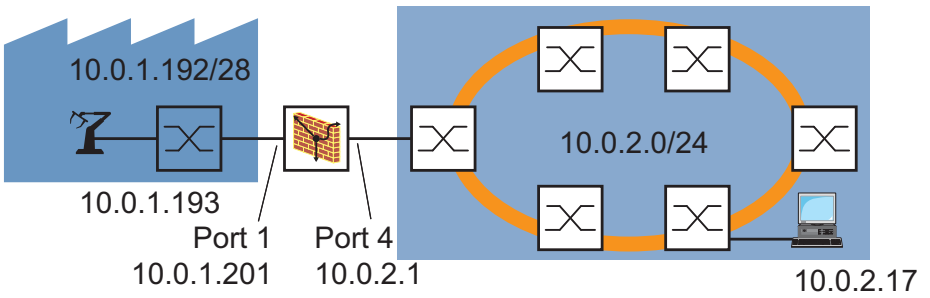


Figure 18: Managing a switch within the production cell from outside

☐ Configure the firewall.
Enter the parameters for converting the IP addresses.

☐ Open the `Network Security:Destination NAT:Rules` dialog.
☐ Click "Create".
You thus add a new entry to the table.
☐ Enter the parameters for the http transmission:
Destination Address: `10.0.2.1`
Destination Port: `8080`
You can freely assign port numbers higher than 1024.
New Destination Address: `10.0.1.193`
New Destination Port: `80`, Web server of the device.
Protocol: `tcp`.
☐ Click "Set and Back" to temporarily save the entry in the configuration.
☐ Click the "Active" field of this entry to activate the entry.
☐ Click "Set" to temporarily save the entry in the configuration.
☐ Click “Create” again.
You thus add an additional entry to the table.
☐ Enter the parameters for the SNMP transmission:
Destination Address: `10.0.2.1`
Destination Port: `8081`
You can freely allocate port numbers higher than 1024.
New Destination Address: `10.0.1.193`
New Destination Port: `161`, for the communication of the applet with the website of the device.
Protocol: `udp`.
☐ Click "Set and Back" again to temporarily save the entry in the configuration.
☐ Click the "Active" field of the additional entry to activate it.

☐ Click "Set" to temporarily save the entries in the configuration.
☐ In the `Network Security:Destination NAT:Assignment` dialog, click the "Assign" button.
In the window that now appears, select the port to which you want to assign this rule. For the "Direction" parameter, the value `ingress` is initially set.

☐ Save the settings in the non-volatile memory.

☐ Open the `Basic Settings:Load/Save` dialog.
☐ Click on “Save” to permanently save the data.

7.3 Helping protect against Denial of Service (DoS)

With this function, the device supports you in protecting against invalid or falsified data traffic targeted at causing the failure of certain services or devices. You have the option of setting individual or multiple filters in order to restrict data traffic for protection against denial-of-service attacks. The activated filters check incoming data packets and discard them as soon as a match with the filter criteria is found.

The `DoS:Global` dialog contains three frames in which you can activate different filters. To activate them, place a checkmark in the corresponding box.

In the "TCP" frame, you can activate up to four filters that only influence TCP packets. Using this filter, you can deactivate what are known as port scans, which attackers could use to try to recognize devices and services offered. The filters operate as follows:

Filter	Action
Null Scan Filter	The device detects and discards TCP packets for which no TCP flags are set.
Xmas Filter	The device detects and discards TCP packets for which the TCP flags FIN, URG and PUSH are simultaneously set.
SYN/FIN Filter	The device detects and discards TCP packets for which the TCP flags SYN and FIN are simultaneously set.
Minimal Header Filter	The device detects and discards TCP packets for which the TCP header is too short.

Table 6: DoS filters for TCP packets

In the "IP" frame, you can set a filter against what are known as land attacks. For these attacks, the underlying tool exploits a vulnerability in the TCP/IP implementation and sends data packets whose source and destination addresses are identical with those of the recipient. When you activate this filter, the device detects such data packets and discards them.

The "ICMP" frame offers you two filter options for ICMP packets. Fragmentation of incoming ICMP packets is a sign of an attack. When you activate this filter, the device detects fragmented ICMP packets and discards them. Using the "Allowed Size" parameter, you can also define the maximum permissible size of the payload of the ICMP packets. The device discards data packets that exceed this byte specification.

Note: You can combine the filters in any way in the `DoS:Global` dialog. When several filters are selected, a logical Or applies: The device discards a data packet if the first or second (or the third, etc.) filter applies to it.

You can find more information on how the filters work and are used in the document Graphical User Interface (GUI) Reference Manual Industrial ETHERNET Firewall (EAGLE20/30).

8 Synchronizing the System Time in the Network

The actual meaning of the term “real time” depends on the time requirements of the application.

The Network Time Protocol (NTP) is accurate to the order of sub-milliseconds.

Examples of application areas include:
- log entries
- time stamping of production data
- production control, etc.

8.1 Entering the Time

If no reference clock is available, you have the option of entering the system time in a device and then using it like a reference clock.

The device contains a Real Time Clock (RTC), or Hardware Clock. The main function of the RTC is to keep the time after removing power from the device. At start-up, the device initializes the System Time to the time taken from the RTC. The device maintains the configured time for 3 hours after charging for 5 min.

The device allows you to set the time in UTC (Coordinated Universal Time). Local time of the device is given by setting an offset in minutes from UTC. Configure the offset, -780 to 840, in minutes.

☐ Open the `Time:Basic Settings` dialog.

▶ System Time (UTC) displays the time received using NTP. The time displayed is the same worldwide. Local time differences are not taken into account.

▶ The "System Time" uses "System Time (UTC)", allowing for the local time difference from "System Time (UTC)".
System Time = "System Time (UTC)" + "Local Offset".

▶ Time Source displays the source of the "System Time (UTC)". The device automatically selects the available source with the greatest accuracy.
The following sources are possible:
  – The source is initially `local`. This is the system clock of the device.
  – If you have activated the NTP client and if the client has synchronized itself, the device sets its time source to `ntp`.

☐ With "Set Time from PC", the device takes the PC time as the system time and calculates the "System Time (UTC)" using the local time difference.
System Time (UTC) = "System Time" - "Local Offset"

▶ The "Local Offset" is for displaying/entering the time difference between the local time and the "System Time (UTC)".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`clock set <YYYY-MM-DD> <HH:MM:SS>`	Set the system time of the device.
`clock timezone offset <-780 to 840>`	Enter the time difference between the local time and the received time in minutes.

8.2 NTP

8.2.1 Description of NTP

The Network Time Protocol (NTP) enables you to synchronize the system time in your network. The device supports the NTP client and the NTP server function.

NTP uses levels, or hierarchies, of clock sources called stratum layers. Stratum layers define the distance from the reference clock. The layers start with zero as the top layer. The stratum zero layer consists of clock devices such as radio clocks, atomic clocks, or GPS clocks. The device operates at stratum layers 1 through 16.

Furthermore, a NTP device operates as a primary server, secondary server, or client. Synchronize the primary NTP-Server directly to the stratum zero layer.

A secondary NTP-Server synchronizes to one or more servers and provides a synchronization signal for one or more servers or clients. When configured as a client-server, the device sends requests to the active NTP-Servers listed in the `Time:NTP:Server` table. As a client-server the device also answers requests sent from dependant servers and clients.

A NTP-Client synchronizes to one or more upstream NTP-Servers. In order to synchronize to the NTP-Server, configure the client devices to send unicast requests or listen for broadcasts.

Note: To obtain as accurate a system time distribution as possible, use multiple NTP servers for an NTP client.

8.2.2 Preparing the NTP configuration

☐ To get an overview of how the time is passed on, draw a network plan with the devices participating in NTP. When planning, bear in mind that the accuracy of the time depends on the signal runtime.

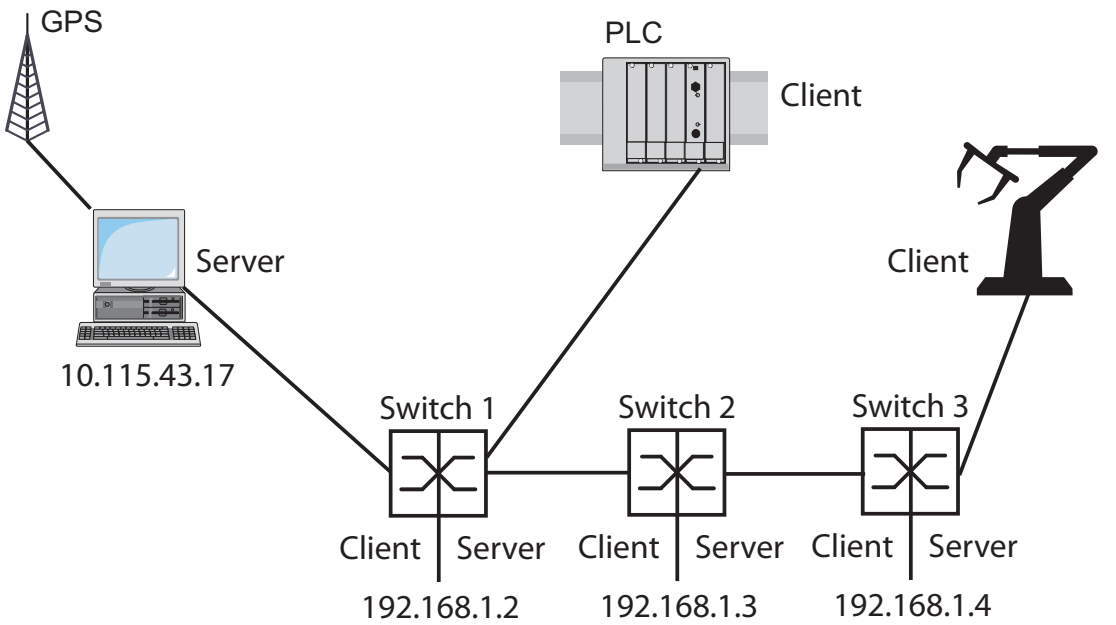


Figure 19: NTP cascading

☐ Enable the NTP function on the devices whose time you want to set using NTP. The NTP server of the device responds to received Unicast requests and sends Broadcast requests as soon as it is configured and enabled.

☐ If no reference clock is available, specify a device as the reference clock and set its system time as accurately as possible.

8.2.3 NTP Configuration

☐ Open the `Time:NTP:Global` dialog.

▶ In the "Client only" frame:
- Client - Enable/disable the function.
- Mode - In `unicast` mode the device sends a request to a designated unicast server and expects a reply from that server. In `broadcast` mode, it sends no request and waits for a broadcast from one or more broadcast servers.

▶ In the "Client and Server" frame:
- Server - Enable/disable the function
- Mode - Set the connection parameters
- Stratum - (Default setting 12.) This setting prevents other clients from using the device as a reference time source.

▶ Configuration of NTP client

☐ Open the `Time:NTP:Global` dialog.

☐ In the "Client only" frame, enable the NTP client of the device.
Before you activate the client, deactivate the "Server" function in the "Client and Server" frame.

☐ In the "Mode" field, select the value `unicast`.

☐ Open the `Time:NTP:Server` dialog.
☐ Click on "Create" to add a time server to the table.
☐ In switch 2, for example, you enter the IP address `192.168.1.2`.
☐ Select the checkbox in the "Active" column to activate the table entry.

▶ Configuration of NTP client server

☐ Open the `Time:NTP:Global` dialog.

☐ Activate the Client and Server function of the device using "Server".

☐ In the "Mode" field, select the value `client-server`.

☐ Open the `Time:NTP:Server` dialog.
☐ Click on "Create" to add a time server to the table.
☐ In switches 1 and 3, for example, you enter the IP address `10.115.43.17`.
☐ Select the checkbox in the "Active" column to activate the table entry.

IP destination address	Send NTP-Packet to
0.0.0.0	Nobody
Multicast address (224.0.0.0 - 239.255.255.254), especially 224.0.1.1 (NTP address)	Multicast address
255.255.255.255	Broadcast address

Table 7: Destination address classes for SNTP and NTP packets

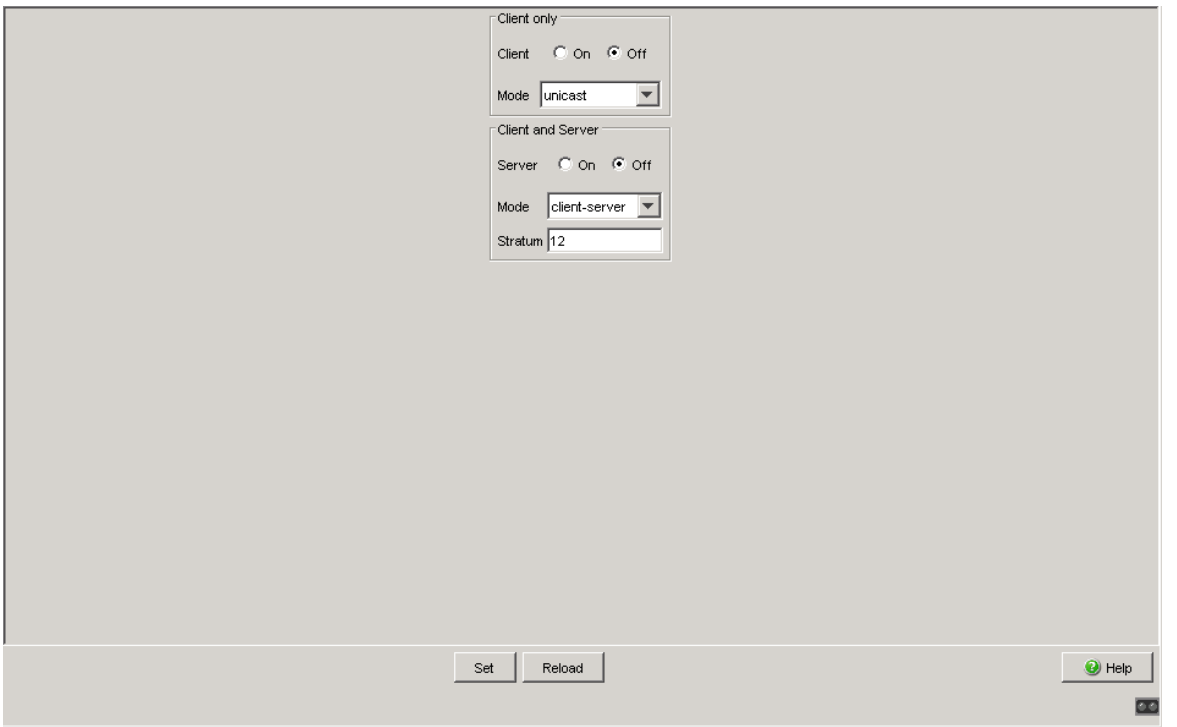


Figure 20: NTP Global dialog

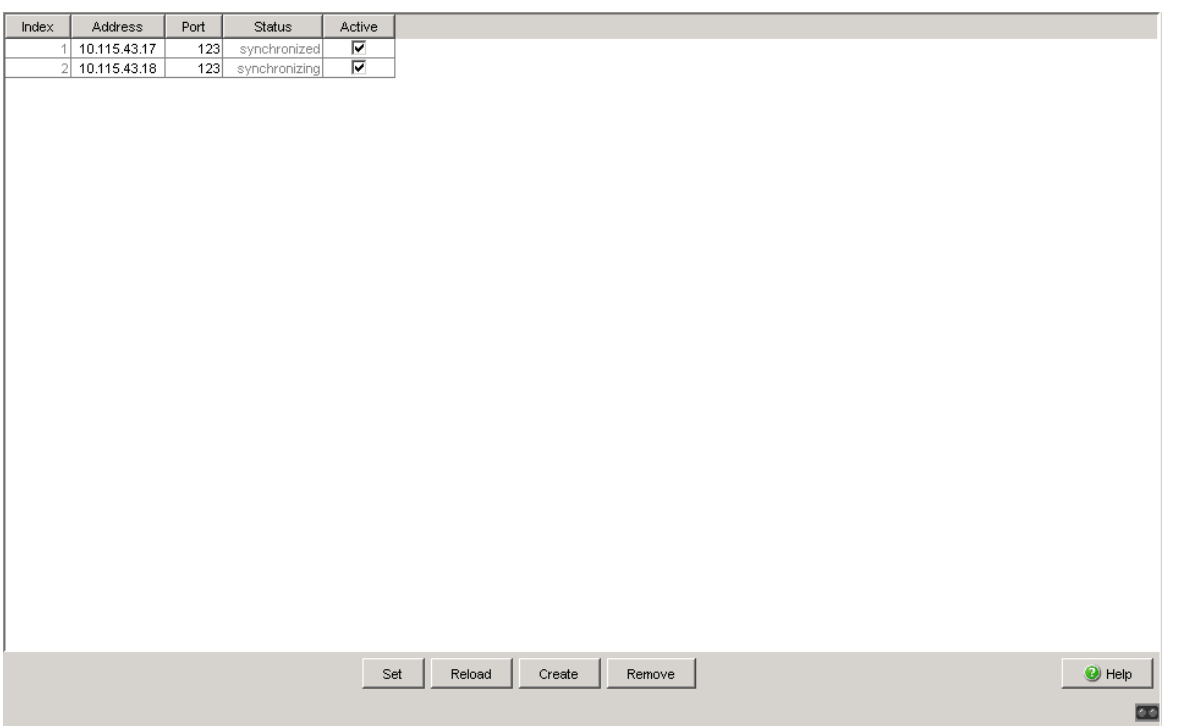


Figure 21: NTP Server dialog

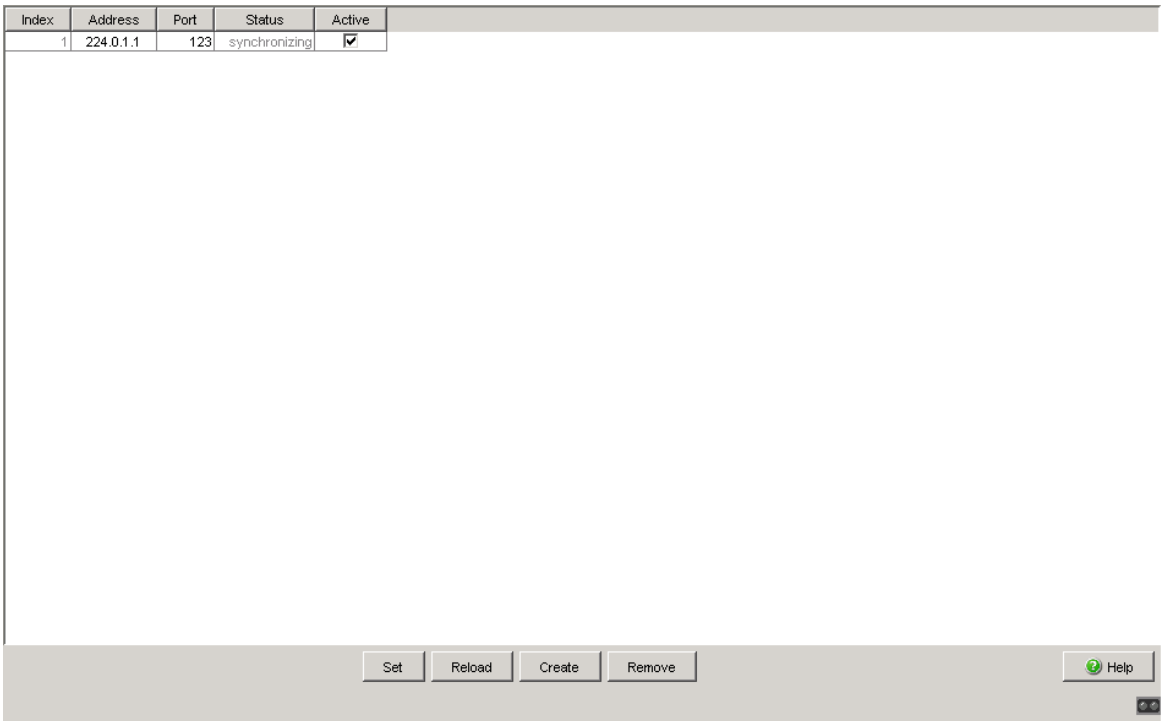


Figure 22: NTP Multicast Groups dialog

Device	192.168.1.2	192.168.1.3	192.168.1.4
Client only frame			
Operation	Off	On	Off
Mode		unicast	
Client and Server frame			
Operation	On	Off	On
Mode	client-server		client-server
Server Address	10.115.43.17	192.168.1.2	10.115.43.17

Table 8: Settings for the example

8.2.4 Multicast Groups

The device also processes Multicast synchronization.

▶ Configuration of NTP Multicast groups

☐ Open the Time:NTP:Global dialog.

☐ In the "Client only" frame, activate the NTP client of the device.
Before you activate the client, deactivate the "Server" function in the "Client and Server" frame.

☐ In the "Mode" field, select the value broadcast.

☐ Open the Time:NTP:Multicast Groups dialog.
☐ Click on "Create" to add a multicast to the table.
☐ Enter the IP address 224.0.1.1 and the UDP port 123.
☐ Select the checkbox in the "Active" column to activate the table entry.

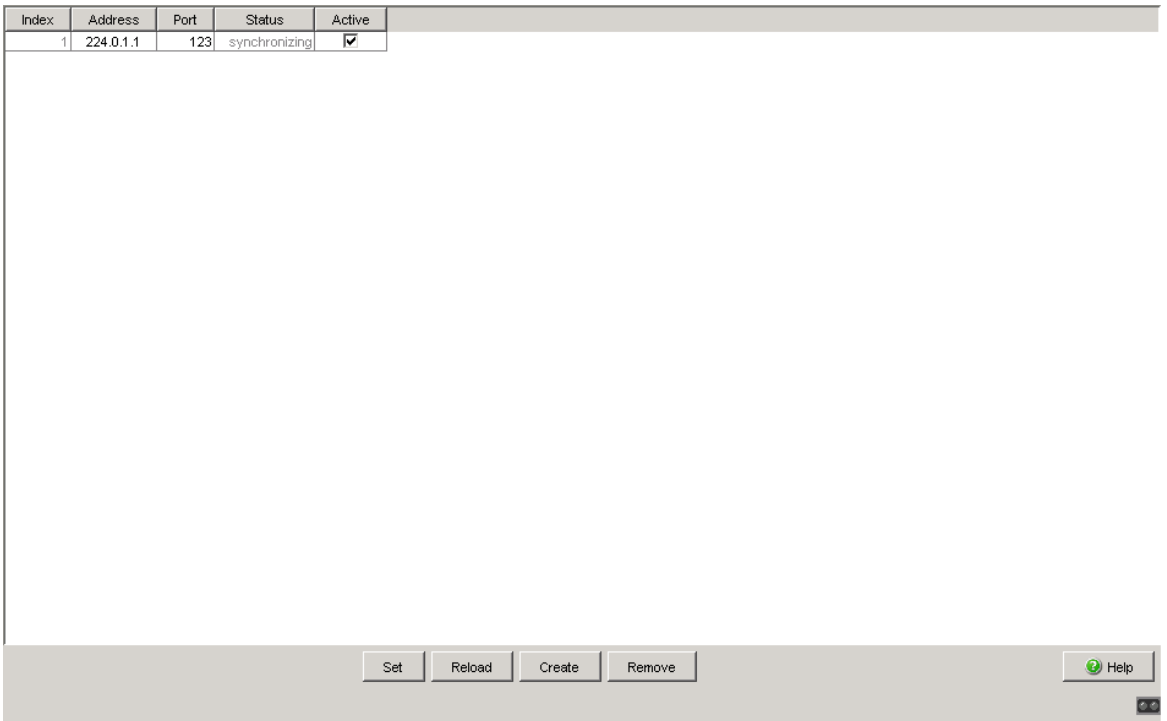


Figure 23: NTP Multicast Groups dialog

9 Network Load Control

To optimize the data transmission, the device provides you with the following functions for controlling the network load.

- Settings for direct packet distribution (MAC address filter)
- Prioritization - QoS
- Flow control
- Virtual LANs (VLANs)

9.1 Direct Packet Distribution

With direct packet distribution, you help protect the device from unnecessary network loads. The device provides you with the following functions for direct packet distribution:

- Store-and-forward
- Multi-address capability
- Aging of learned addresses
- Static address entries
- Disabling the direct packet distribution

9.1.1 Store and Forward

All data received by the device is stored, and its validity is checked. Invalid and defective data packets (> 1522 bytes or CRC errors) as well as fragments (> 64 bytes) are rejected. Valid data packets are forwarded by the device.

9.1.2 Multi-Address Capability

The device learns source addresses for a port from packets with

- unknown destination addresses,
- destination addresses for this device,
- multicast/broadcast destination addresses

in the destination address field that are received on this port. The device enters learned source addresses in its filter table.
The device can learn up to 16,000 addresses. This is necessary if more than one terminal device is connected to one or more ports. It is thus possible to connect several independent subnetworks to the device.

9.1.3 Aging of Learned Addresses

The device monitors the age of the learned addresses. Address entries which exceed a particular age - the aging time - are deleted by the device from its address table. Minimum configurable time is 10 seconds.
Data packets with an unknown destination address are flooded by the device.
Data packets with known destination addresses are selectively transmitted by the device.

Note: A reboot deletes the learned address entries.

☐ Open the `Switching:Global` dialog.

☐ Enter the aging time for every dynamic entry in the range from 10 to 500,000 seconds (unit: 1 second; default setting: 30).

9.1.4 Entering Static Addresses

The filter function selects data packets according to defined patterns, known as filters. These patterns are assigned distribution rules. This means that a data packet received by a device on a port is compared with the patterns. If there is a pattern that matches the data packet, the device then sends or blocks this data packet according to the distribution rules for the relevant ports.

The following are valid filter criteria:

- Destination address
- Broadcast address
- Multicast address
- VLAN membership

The individual filters are stored in the filter table (Forwarding Database, FDB). The FDB consists of the following parts:

- A table that contains information about unicast entries for which the device has forwarding and/or filtering information. (`dot1qTpFdbTable`).
- A table containing filtering information for VLANs configured into the bridge by (local or network) management, or learnt dynamically. This table specifies a set of ports to which frames received on a VLAN for this FDB and containing a specific Group destination address are allowed to be forwarded. (`dot1qTpGroupTable`)

An address entered statically cannot be overwritten through learning.

Note: This filter table allows you to create up to 100 filter entries for static Unicast/Multicast addresses.

☐ Open the `Switching:Filter for MAC addresses` dialog.

Each row of the filter table represents one filter. Filters specify the way in which data packets are sent. They are either created automatically by the device (learned status) or manually. Data packets whose destination address is entered in the table are sent from the receiving port to the ports marked in the table. Data packets whose destination address is not in the table are sent from the receiving port to every port. You click on "Create" to create new filters. The following status settings are possible:

- `learned`: The filter was created automatically by the device.
- `permanent`: The filter is stored permanently in the device or on the URL (see on page 49 “Saving settings”)
- `invalid`: With this status you delete a manually created filter.
- `mgmt`: This is the MAC Address of the managing device.

Click on the "Status" cell of a learned filter allows you to change the category to `permanent or invalid`.

To delete entries with the `learned` status from the filter table, select the `Basic Settings:Restart` dialog and click on "Reset MAC address table".

9.2 QoS/Priority

9.2.1 Description of Prioritization

This function helps prevent time-critical data traffic such as language/video or real-time data from being disrupted by less time-critical data traffic during periods of heavy traffic. By assigning high traffic classes for time-critical data and low traffic classes for less time-critical data, this provides optimal data flow for time-critical data traffic.

The device supports 8 priority queues (IEEE 802.1D standard traffic classes). The received data packets are assigned to these classes by:

Data packets can contain prioritizing/QoS information:

- VLAN priority based on IEEE 802.1Q/ 802.1D (Layer 2)
- Type of Service (ToS) or DiffServ (DSCP) for VLAN Management IP packets (Layer 3)

9.2.2 VLAN tagging

The VLAN tag is integrated into the MAC data frame for the VLAN and Prioritization functions in accordance with the IEEE 802.1Q standard. The VLAN tag consists of 4 bytes. It is inserted between the source address field and the type field.

For data packets with a VLAN tag, the device evaluates:
- the priority information,
- the VLAN information if VLANs have been set.

Data packets with VLAN tags containing priority information but no VLAN information (VLAN ID = 0), are known as Priority Tagged Frames.

Priority entered	Traffic class (default setting)	IEEE 802.1D traffic type
0	2	Best effort (default)
1	0	Background
2	1	Standard
3	3	Excellent effort
4	4	Controlled load (streaming multimedia)
5	5	Video, less than 100 milliseconds of latency and jitter
6	6	Voice, less than 10 milliseconds of latency and jitter
7	7	Network control reserved traffic

Table 9: Assignment of the priority entered in the tag to the 8 traffic classes

Note: Network protocols and redundancy mechanisms use the highest traffic class 7. Therefore, select other traffic classes for application data.

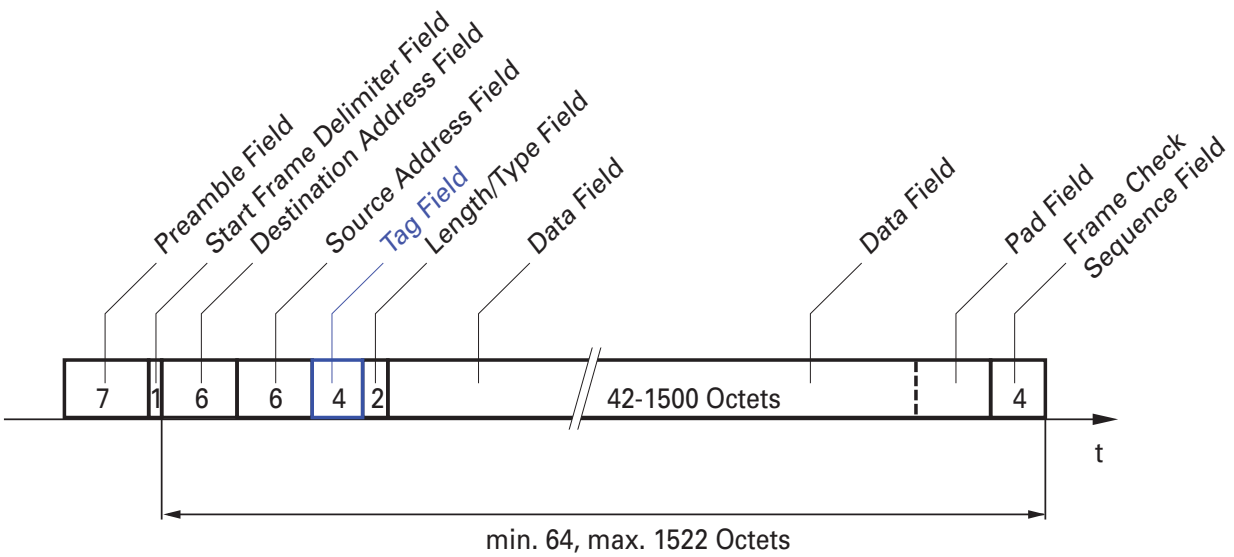


Figure 24: Ethernet data packet with tag

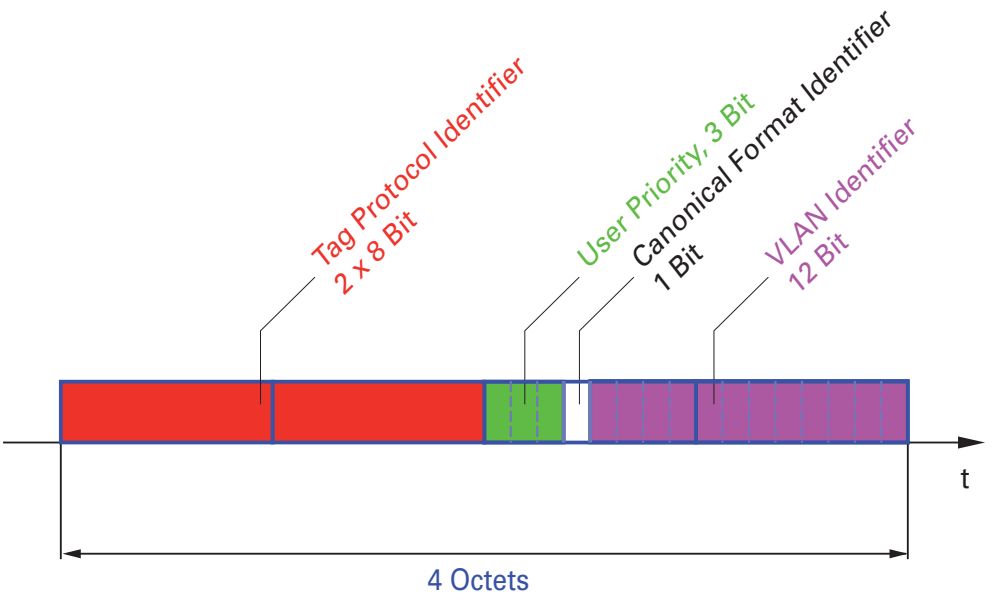


Figure 25: Tag format

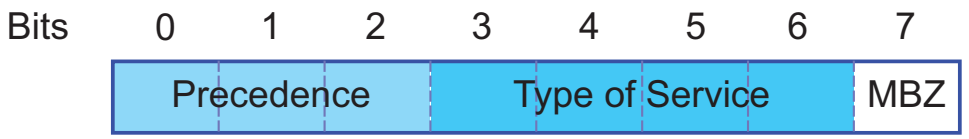
When using VLAN prioritizing, consider the following special features:

- End-to-end prioritizing requires the VLAN tags to be transmitted to the entire network, which means that every network component needs to be VLAN-capable.
- Routers cannot receive or send packets with VLAN tags via port-based router interfaces.

9.2.3 IP ToS / DiffServ

The Management VLAN has the ability to handle traffic using IP Type of Service and Differential Services Code Point (DHCP).

- **TYPE of Service**
  The Type of Service (ToS) field in the IP header (see table 10) has been part of the IP protocol from the start, and it is used to differentiate various services in IP networks. Even back then, there were ideas about differentiated treatment of IP packets, due to the limited bandwidth available and the unreliable connection paths. Because of the continuous increase in the available bandwidth, there was no need to use the ToS field. Only with the real-time requirements of today's networks has the ToS field become significant again. Selecting the ToS byte of the IP header enables you to differentiate between different services. However, this field is not widely used in practice.



Bits (0-2): IP Precedence Defined	Bits (3-6): Type of Service Defined	Bit (7)
111 - Network Control	0000 - [all normal]	0 - Must be zero
110 - Internetwork Control	1000 - [minimize delay]	
101 - CRITIC / ECP	0100 - [maximize throughput]	
100 - Flash Override	0010 - [maximize reliability]	
011 - Flash	0001 - [minimize monetary cost]	
010 - Immediate		
001 - Priority		
000 - Routine		

Table 10: ToS field in the IP header

Differentiated Services

The “Differentiated Services” field in the IP header, newly defined in RFC 2474 - often known as the DiffServ code point or DSCP - replaces the ToS field and is used to tag the individual packets with a DSCP. Here the packets are divided into different quality classes. The first 3 bits of the DSCP are used to divide the packets into classes. The next 3 bits are used to further divide the classes on the basis of different criteria. In contrast to the ToS byte, DiffServ uses 6 bits for the division into classes. This results in up to 64 different service classes.

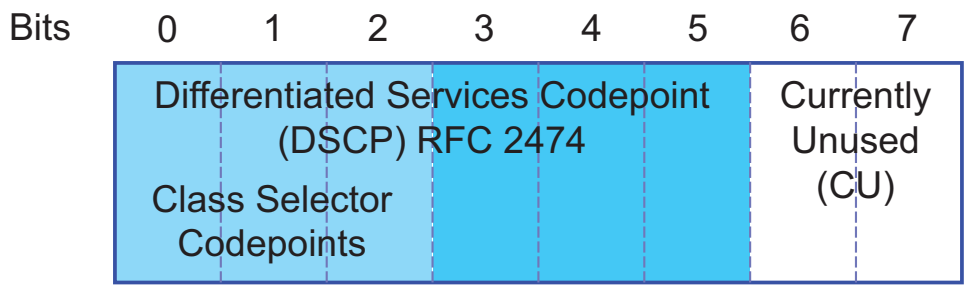


Figure 26: Differentiated Services field in the IP header

The different DSCP values get the device to employ a different forwarding behavior, namely Per-Hop Behavior (PHB). PHB classes:

- Class Selector (CS0-CS7): For reasons of compatibility to TOS/IP Precedence
- Expedited Forwarding (EF): Premium service.
  Reduced delay, jitter + packet loss (RFC 2598)
- Assured Forwarding (AF): Provides a differentiated schema for handling different data traffic (RFC 2597).
- Default Forwarding/Best Effort: No particular prioritizing.

The PHB class selector assigns the 7 possible IP precedence values from the old ToS field to specific DSCP values, for downward compatibility.

ToS Meaning	Precedence Value	Assigned DSCP
Network Control	111	CS7 (111000)
Internetwork Control	110	CS6 (110000)
Critical	101	CS5 (101000)
Flash Override	100	CS4 (100000)
Flash	011	CS3 (011000)
Immediate	010	CS2 (010000)
Priority	001	CS1 (001000)
Routine	000	CS0 (000000)

Table 11: Assigning the IP precedence values to the DSCP value

9.2.4 Management prioritization

To have full access to the management of the device, even in situations of high network load, the device enables you to prioritize management packets. In prioritizing management packets (SNMP, Telnet, etc.), the device sends the management packets with priority information.

- On Layer 2 the device modifies the VLAN priority in the VLAN tag. For this function to be useful, the configuration of the corresponding ports must permit the sending of packets with a VLAN tag.

- On Layer 3 the device modifies the IP-DSCP value.

9.2.5 Handling of Traffic Classes

For the handling of traffic classes, the device provides:

- Strict Priority

Description of Strict Priority

With the Strict Priority setting, the device first transmits every data packet that has a higher traffic class (higher priority) before transmitting a data packet with the next traffic class. The device transmits a data packet with the lowest traffic class (lowest priority) only when there are no other data packets remaining in the queue. In worse-case situations, the device never sends packets with lower priority when a high volume of higher-priority traffic is queued up for transmission on this port.
In applications that are time- or latency-critical, such as VoIP or video, Strict Priority enables high-priority data to be sent immediately.

9.2.6 Setting prioritization

Configuring Layer 2 management priority

☐ Configure the VLAN ports to which the device sends management packets as a member of the VLAN that sends data packets with a tag (see on page 128 “Examples of VLANs”).

☐ Open the `QoS/Priority:Global` dialog.
☐ In the "VLAN Priority for Management packets" field, you enter the value of the VLAN priority.

`enable`	Switch to the privileged EXEC mode.
`network management priority dot1p 7`	Assign the value 7 to the management priority so that management packets with the highest priority are sent.
`exit`	Switch to the privileged EXEC mode.
`show network parms`	Displays the management VLAN priority.

```
Local IP Address.............................. 10.0.1.116
Subnetmask.................................... 255.255.255.0
Gateway Address............................... 10.0.1.200
Protocol...................................... none
Management VLAN ID............................ 1
Management VLAN priority...................... 7
Management IP-DSCP value...................... 0
```

Configuring Layer 3 management priority

☐ Open the `QoS/Priority:Global` dialog.
☐ In the "IP DSCP Value for Management packets" field, you enter the IP DSCP value with which the device sends management packets.

`enable`	Switch to the privileged EXEC mode.
`network management priority ip-dscp 56`	Assign the value 56 to the management priority so that management packets with the highest priority are handled.
`show network parms`	Displays the management VLAN priority.

```
Local IP Address.............................. 10.0.1.116
Subnetmask.................................... 255.255.255.0
Gateway Address............................... 10.0.1.200
Protocol...................................... none
Management VLAN ID............................ 1
Management VLAN Priority...................... 7
Management IP-DSCP Value...................... 56
```

9.3 Flow Control

9.3.1 Description of Flow Control

Flow control is a mechanism which acts as an overload protection for the device. During periods of heavy traffic, it holds off additional traffic from the network.

The example (see fig. 27) shows a graphic illustration of how the flow control works. Workstations 1, 2 and 3 want to simultaneously transmit a large amount of data to Workstation 4. The combined bandwidth of Workstations 1, 2 and 3 is greater than the bandwidth of Workstation 4. This leads to an overflow of the receive queue of port 4. The funnel on the left symbolizes this status.

If the flow control function on ports 1, 2 and 3 of the device is turned on. The device reacts before the funnel overflows. The funnel on the right illustrates ports 1, 2 and 3 sending a message to the transmitting devices to control the transmition speed. This results in the receiving port no longer being overwhelmed and is able to process the incoming traffic.

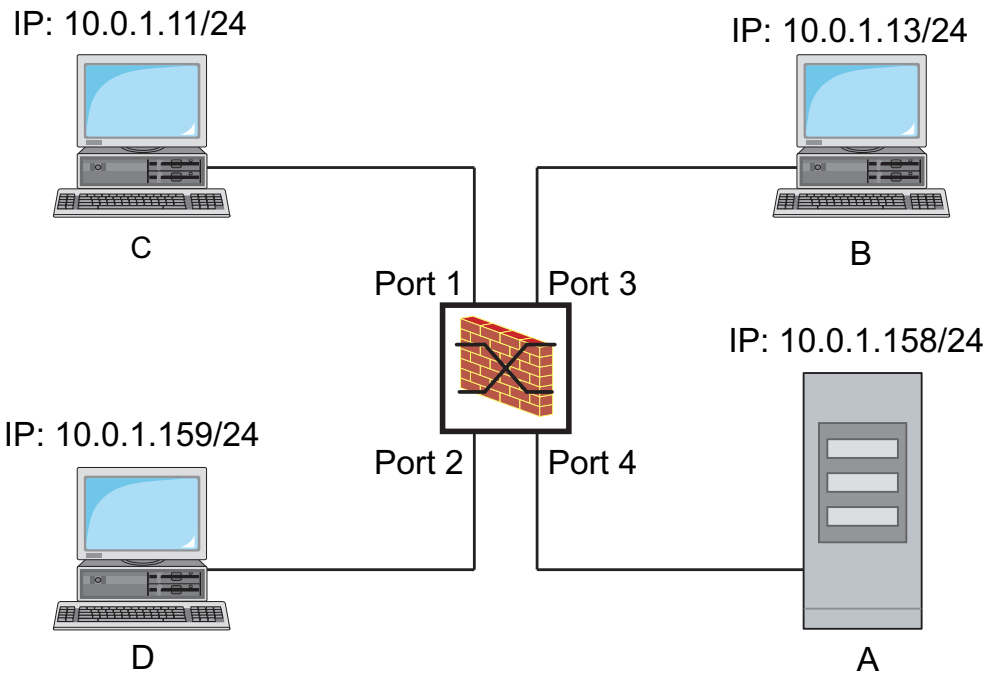


Figure 27: Example of flow control

- **Flow Control with a full duplex link**
  In the example above there is a full duplex link between Workstation 2 and the device. Before the send queue of port 2 overflows, the device sends a request to Workstation 2 to include a small break in the sending transmission.

- **Flow Control with a half duplex link**
  In the example above there is a half duplex link between Workstation 2 and the device. Before the send queue of port 2 overflows, the device sends data back so that Workstation 2 detects a collision and interrupts the sending process.

9.3.2 Setting the Flow Control

☐ Open the `Basic Settings:Port Configuration` dialog.
In the "Flow Control" column, you tick the checkbox of the corresponding port to activate the flow control. For this, you also activate the global "Activate Flow Control" switch in the `Switching:Global` dialog.

☐ Open the `Switching:Global` dialog.
With this dialog you can:
- switch off the flow control for every port or
- switch on the flow control for those ports on which the flow control is selected in the port configuration table.

Note: When you are using a redundancy function, you deactivate the flow control on the participating ports. Default setting: flow control deactivated globally and activated on every port.
If the flow control and the redundancy function are active at the same time, the redundancy may not work as intended.

9.4 VLANs

9.4.1 VLAN Description

In the simplest case, a virtual LAN (VLAN) consists of a group of network participants in one network segment who can communicate with each other as if they belonged to a separate LAN.

More complex VLANs span out over multiple network segments and are also based on logical (instead of only physical) connections between network participants. As you can see, VLANs are an element of flexible network design. It is easier to reconfiguring logical connections centrally than cable connections.

The IEEE 802.1Q standard defines the VLAN function.

The most important benefits of VLANs are:

- Network load limiting
  VLANs reduce the network load considerably as the devices transmit Broadcast/Multicast data packets and Unicast packets with unknown (unlearned) destination addresses only within the virtual LAN. The rest of the data network is unaffected by this.

- Flexibility
  You have the option of forming user groups flexibly based on the function of the participants and not on their physical location or medium.

- Clarity
  VLANs give networks a clear structure and make maintenance easier.

9.4.2 Examples of VLANs

The following practical examples provide a quick introduction to the structure of a VLAN.

Note: When configuring VLANs you use an interface for management that will not be changed. For this example, you use either interface 1/6 or the V.24 serial connection to configure the VLANs.

Example 1

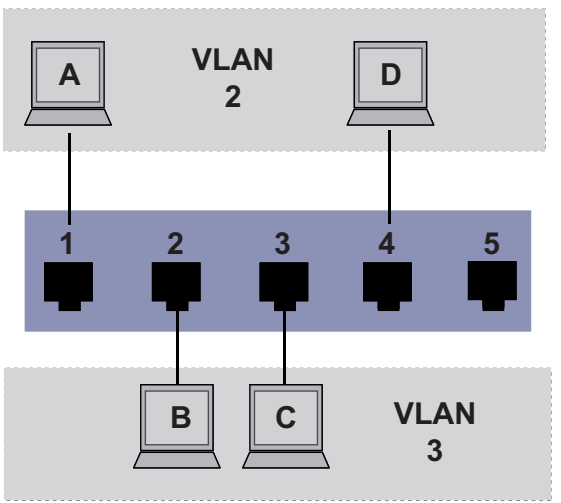


Figure 28: Example of a simple port-based VLAN

The example shows a minimal VLAN configuration (port-based VLAN). An administrator has connected multiple terminal devices to a transmission device and assigned them to 2 VLANs. This effectively prohibits any data transmission between the VLANs, whose members communicate only within their own VLANs.
When setting up the VLANs, you create communication rules for every port, which you enter in incoming (ingress) and outgoing (egress) tables. The ingress table specifies which VLAN ID a port assigns to the incoming data packets. Hereby, you use the port address of the terminal device to assign it to a VLAN.

The egress table specifies at which ports the device may send the frames from this VLAN. Your entry also defines whether the device tags the Ethernet frames sent from this port.

- `T` = with tag field (T = tagged, marked)
- `U` = without tag field (U = untagged, not marked)

For the above example, the status of the TAG field of the data packets is not relevant, so you can generally set it to "U“.

Terminal	Port	Port VLAN identifier (PVID)
A	1	2
B	2	3
C	3	3
D	4	2
	5	1

Table 12: Ingress table

VLANID	Port				
	1	2	3	4	5
1					U
2	U			U	
3		U	U		

Table 13: Egress table

Proceed as follows to perform the example configuration:

☐ Configure VLAN

☐ Open the `Switching:VLAN:Static` dialog.

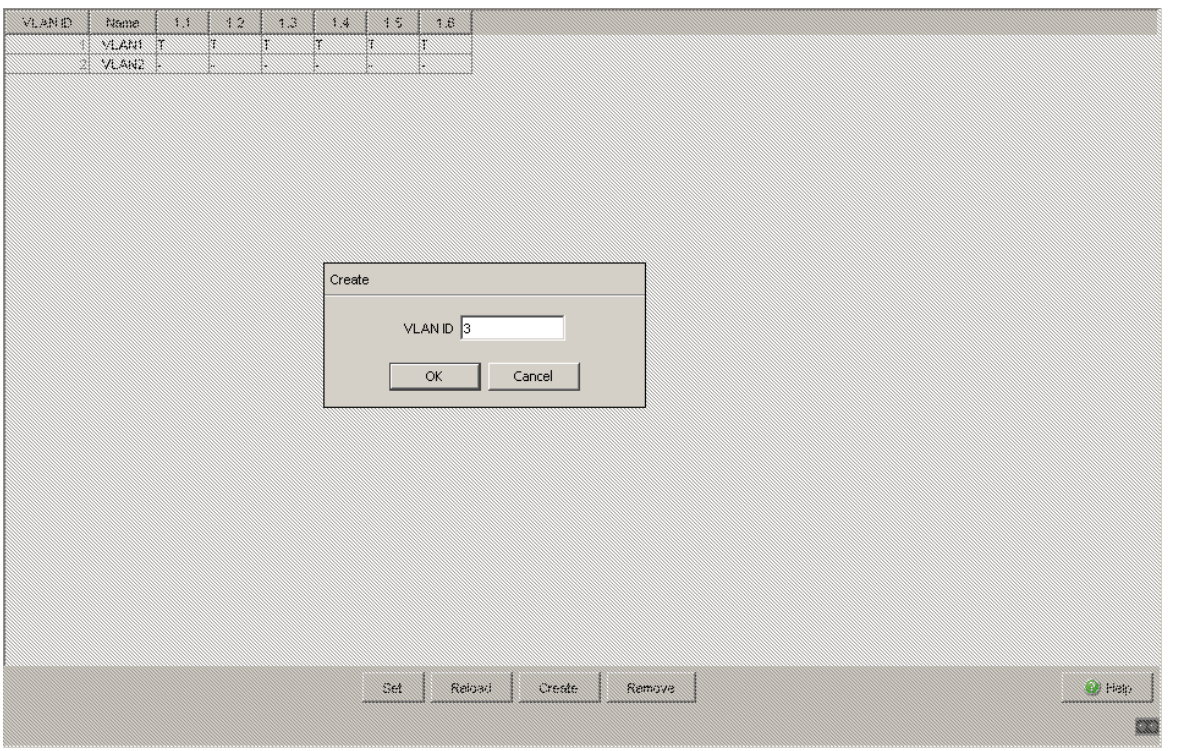


Figure 29: Creating and naming new VLANs

☐ Click on "Create" to open the window for entering the VLAN ID.

☐ Assign VLAN ID `2` to the VLAN.

☐ Click "OK".

☐ You give this VLAN the name VLAN2 by clicking on the field and entering the name. Also change the name for VLAN 1 from `Default` to `VLAN1`.

☐ Repeat the previous steps and create another VLAN with the VLAN ID `3` and the name `VLAN3`.

`enable`	Switch to the privileged EXEC mode.
`vlan database`	Switch to the VLAN configuration mode.
`vlan add 2`	Create a new VLAN with the VLAN ID 2.
`name 2 VLAN2`	Give the VLAN with the VLAN ID 2 the name VLAN2.
`vlan add 3`	Create a new VLAN with the VLAN ID 3.
`name 3 VLAN3`	Give the VLAN with the VLAN ID 3 the name VLAN3.
`name 1 VLAN1`	Give the VLAN with the VLAN ID 1 the name VLAN1.

```
exit                                    Leave the VLAN configuration mode.
show vlan brief                         Display the current VLAN configuration.
Max. VLAN ID..................................... 4042
Max. supported VLANs............................. 64
Number of currently configured VLANs............ 3

VLAN ID VLAN Name                       VLAN Type VLAN Creation Time
---- -------------------------------- --------- -------------------
1       VLAN1                           default    0 days, 00:00:05
2       VLAN2                           static     0 days, 02:44:29
3       VLAN3                           static     0 days, 02:52:26
```

☐ Configuring the ports

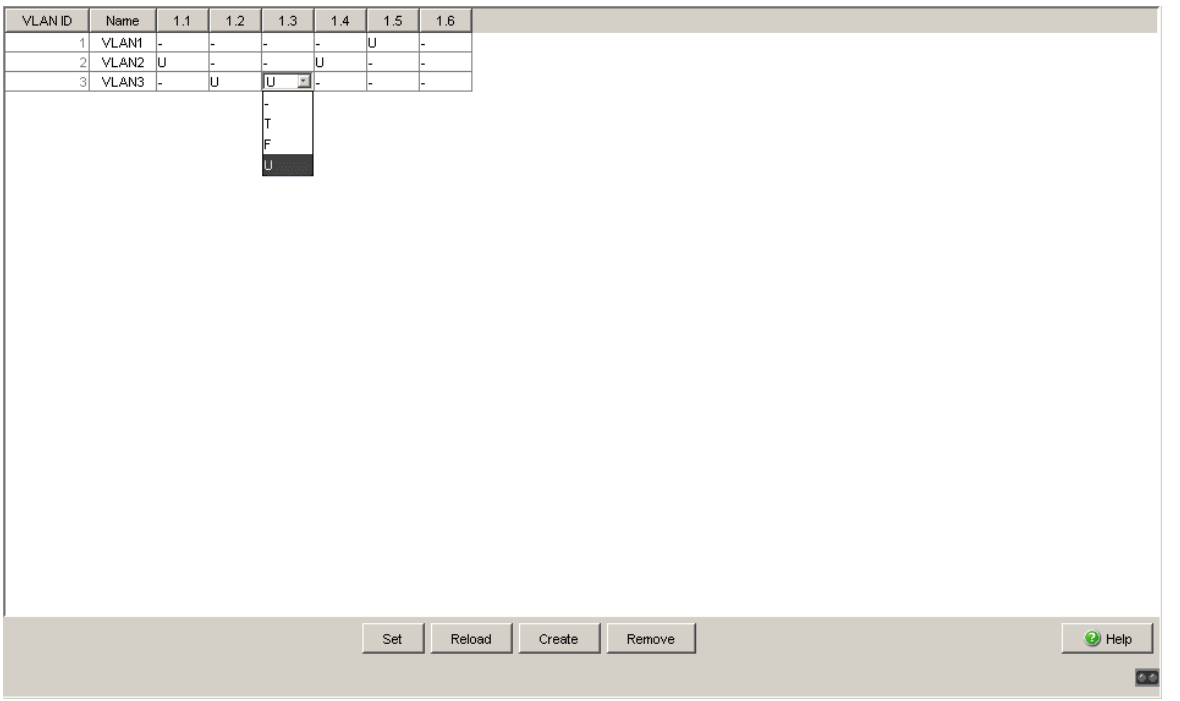


Figure 30: Defining the VLAN membership of the ports.

☐ Assign the ports of the device to the corresponding VLANs by clicking on the related table cell to open the selection menu and define the status. The selection options are:
- `-` = currently not a member of this VLAN (GVRP allowed)
- `T` = member of VLAN; send data packets with tag
- `U` = Member of the VLAN; send data packets without tag
- `F` = not a member of the VLAN (also disabled for GVRP)

Because terminal devices usually do not interpret data packets with a tag, you select the `U` setting here.

☐ Click on "Set" to temporarily save the entry in the configuration.

☐ Open the `Switching:VLAN:Port` dialog.

☐ Assign the Port VLAN ID of the related VLANs (2 or 3) to the individual ports - see table.

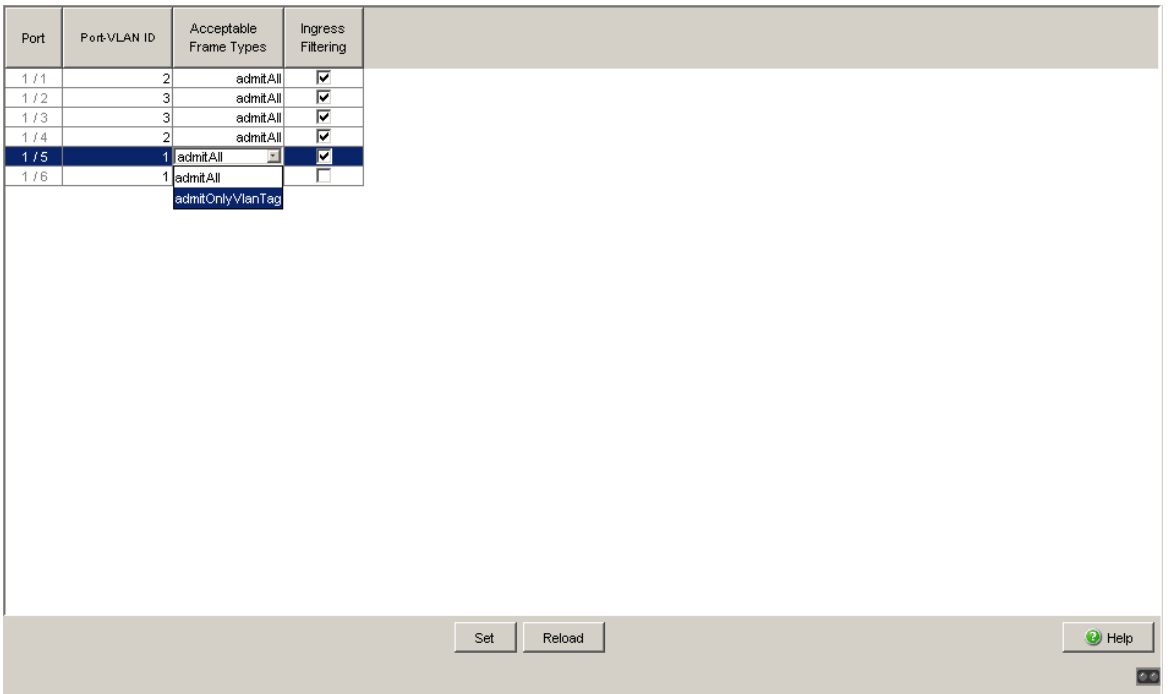


Figure 31: Assigning and saving "Port VLAN ID", "Acceptable Frame Types" and "Ingress Filtering"

- ☐ Because terminal devices usually do not send data packets with a tag, you select the "admitAll" setting for the `Acceptable Frame Types`.
- ☐ The setting for "Ingress Filtering" does not affect how this example functions.
- ☐ Click on "Set" to temporarily save the entry in the configuration.
- ☐ Open the `Basic Settings:External Memory` dialog.
- ☐ Make sure that the "Auto-save config on envm" checkbox is activated. To save the configuration permanently on the external memory, click on "Set".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`vlan participation include 2`	Port 1/1 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/1 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.
`interface 1/2`	Switch to the interface configuration mode for interface 1/2.
`vlan participation include 3`	Port 1/2 becomes member untagged in VLAN 3.
`vlan pvid 3`	Port 1/2 is assigned the port VLAN ID 3.
`exit`	Switch to the Configuration mode.

```
interface 1/3                    Switch to the Interface Configuration mode of
                                 Interface 1/3.
vlan participation include 3     Port 1/3 becomes member untagged in VLAN 3.
vlan pvid 3                      Port 1/3 is assigned the port VLAN ID 3.
exit                             Switch to the Configuration mode.
interface 1/4                    Switch to the interface configuration mode of
                                 interface 1/4.
vlan participation include 2     Port 1/4 becomes member untagged in VLAN 2.
vlan pvid 2                      Port 1/4 is assigned the port VLAN ID 2.
exit                             Switch to the Configuration mode.
exit                             Switch to the privileged EXEC mode.
show vlan id 3                   Show details for VLAN 3.
VLAN ID           : 3
VLAN Name         : VLAN3
VLAN Type         : Static
VLAN Creation Time: 0 days, 02:52:26 (System Uptime)
Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1            -      Autodetect   Tagged
1/2         Include   Include      Untagged
1/3         Include   Include      Untagged
1/4            -      Autodetect   Tagged
1/5            -      Autodetect   Tagged
```

Example 2

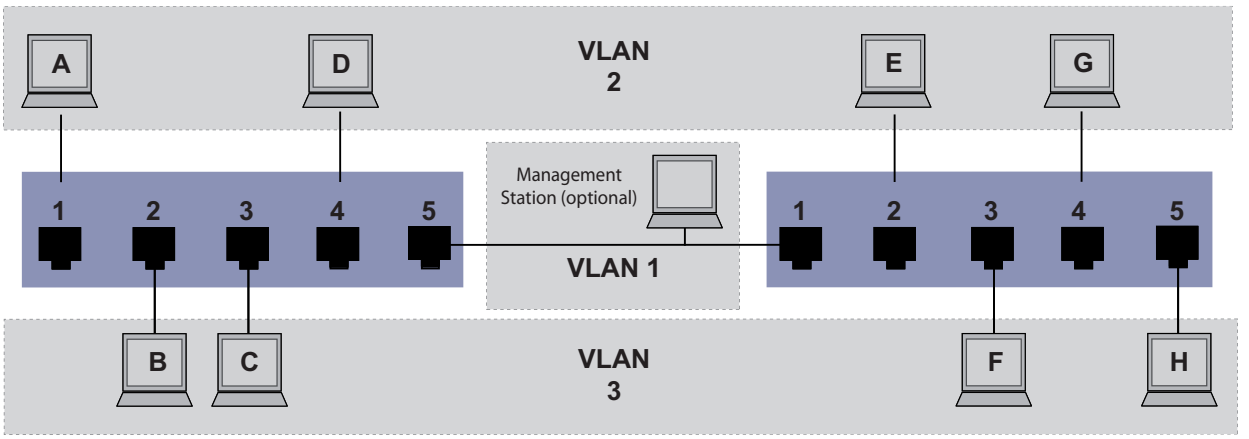


Figure 32: Example of a more complex VLAN configuration

The second example shows a more complex configuration with 3 VLANs (1 to 3). Along with the Switch from example 1, you use a 2nd Switch (on the right in the example).
The terminal devices of the individual VLANs (A to H) are spread over 2 transmission devices (Switches). Such VLANs are therefore known as distributed VLANs. An optional Management Station is also shown, which enables access to the network components if the VLAN is configured correctly.

Note: In this case, VLAN 1 has no significance for the terminal device communication, but it is required for the administration of the transmission devices via what is known as the Management VLAN.

As in the previous example, uniquely assign the ports with their connected terminal devices to a VLAN. With the direct connection between the two transmission devices (uplink), the ports transport packets for both VLANs. To differentiate these you use “VLAN tagging”, which handles the frames accordingly (see on page 116 “VLAN tagging”). The assignment to the respective VLANs is thus maintained.

Proceed as follows to perform the example configuration:
Add Uplink Port 5 to the ingress and egress tables from example 1.
Create new ingress and egress tables for the right switch, as described in the first example.

The egress table specifies at which ports the Firewall may send the frames from this VLAN. Your entry also defines whether the device tags the Ethernet frames sent from this port.

- `T` = with tag field (T = tagged, marked)
- `U` = without tag field (U = untagged, not marked)

In this example, tagged frames are used in the communication between the transmission devices (uplink), as frames for different VLANs are differentiated at these ports.

Terminal	Port	Port VLAN identifier (PVID)
A	1	2
B	2	3
C	3	3
D	4	2
Uplink	5	1

Table 14: Ingress table for device on left

Terminal	Port	Port VLAN identifier (PVID)
Uplink	1	1
E	2	2
F	3	3
G	4	2
H	5	3

Table 15: Ingress table for device on right

VLAN ID	Port				
	1	2	3	4	5
1					U
2	U			U	T
3		U	U		T

Table 16: Egress table for device on left

VLAN ID	Port				
	1	2	3	4	5
1	U				
2	T	U		U	
3	T		U		U

Table 17: Egress table for device on right

The communication relationships here are as follows: terminal devices on ports 1 and 4 of the left device and terminal devices on ports 2 and 4 of the right device are members of VLAN 2 and can thus communicate with each other. The behavior is the same for the terminal devices at ports 2 and 3 of the left device and the terminal devices at ports 3 and 5 of the right device. These belong to VLAN 3.
The terminal devices “see” their respective part of the network. Participants outside this VLAN cannot be reached. Broadcast and Multicast data packets, and Unicast packets with unknown (unlearned) destination addresses, are also only sent within a VLAN.

Here, VLAN tagging (IEEE 801.1Q) is used within the VLAN with the ID 1 (Uplink). You can see this from the letter T in the egress table of the ports.

The configuration of the example is the same for the device on the right. Proceed in the same way, using the ingress and egress tables created above to adapt the previously configured left device to the new environment.

Proceed as follows to perform the example configuration:

☐ Configure VLAN

☐ Open the `Switching:VLAN:Static` dialog.

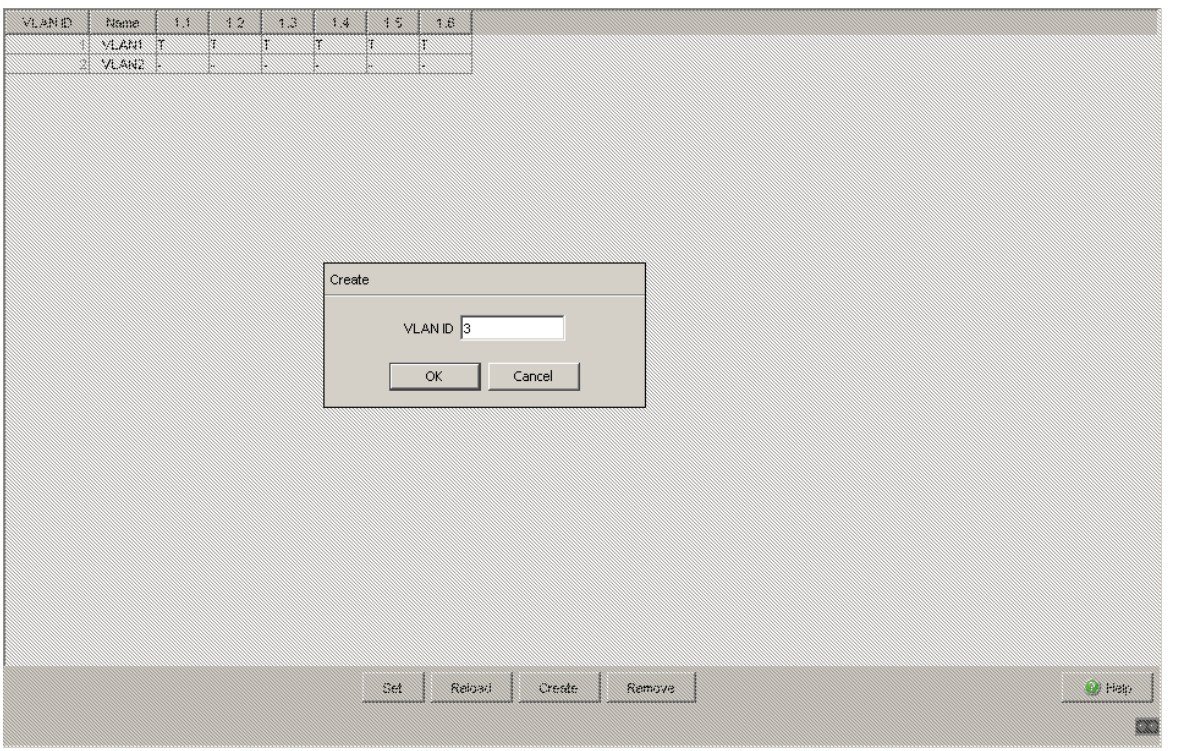


Figure 33: Creating and naming new VLANs

☐ Click on "Create" to open the window for entering the VLAN ID.

☐ Assign VLAN ID `2` to the VLAN.

☐ You give this VLAN the name VLAN2 by clicking on the field and entering the name. Also change the name for VLAN 1 from `Default` to `VLAN1`.

☐ Repeat the previous steps and create another VLAN with the VLAN ID 3 and the name `VLAN3`.

`enable`	Switch to the privileged EXEC mode.
`vlan database`	Switch to the VLAN configuration mode.
`vlan add 2`	Create a new VLAN with the VLAN ID 2.
`name 2 VLAN2`	Give the VLAN with the VLAN ID 2 the name VLAN2.
`vlan add 3`	Create a new VLAN with the VLAN ID 3.
`name 3 VLAN3`	Give the VLAN with the VLAN ID 3 the name VLAN3.
`name 1 VLAN1`	Give the VLAN with the VLAN ID 1 the name VLAN1.
`exit`	Switch to the privileged EXEC mode.

```
show vlan brief                    Display the current VLAN configuration.
Max. VLAN ID..................................... 4042
Max. supported VLANs............................. 64
Number of currently configured VLANs............ 3

VLAN ID VLAN Name                        VLAN Type VLAN Creation Time
------- -------------------------------- --------- -------------------
1       VLAN1                            default    0 days, 00:00:05
2       VLAN2                            static     0 days, 02:44:29
3       VLAN3                            static     0 days, 02:52:26
```

☐ Configuring the ports

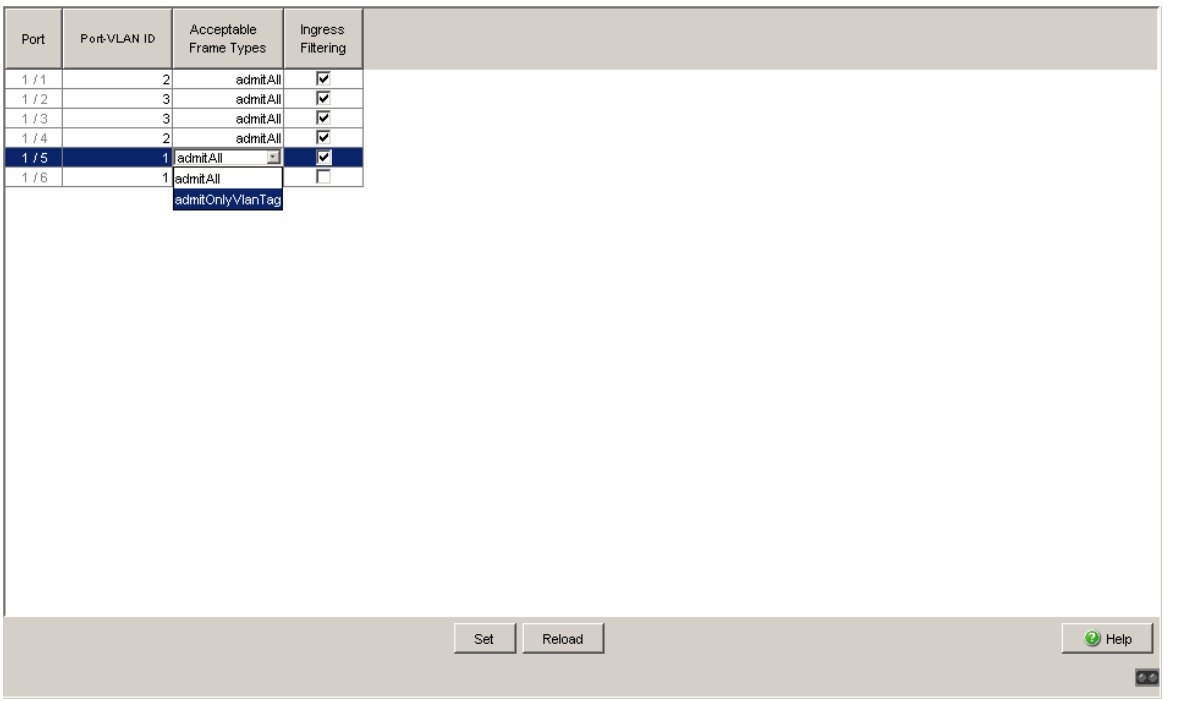


Figure 34: Defining the VLAN membership of the ports.

☐ Assign the ports of the device to the corresponding VLANs by clicking on the related table cell to open the selection menu and define the status. The selection options are:
- `-` = currently not a member of this VLAN (GVRP allowed)
- `T` = member of VLAN; send data packets with tag
- `U` = Member of the VLAN; send data packets without tag
- `F` = not a member of the VLAN (also disabled for GVRP)

Because terminal devices usually do not interpret data packets with a tag, you select the `U` setting. You only select the `MT` setting at the uplink port at which the VLANs communicate with each other.

☐ Click on "Set" to temporarily save the entry in the configuration.

☐ Open the `Switching:VLAN:Port` dialog.

☐ Assign the ID of the related VLANs (1 to 3) to the individual ports.

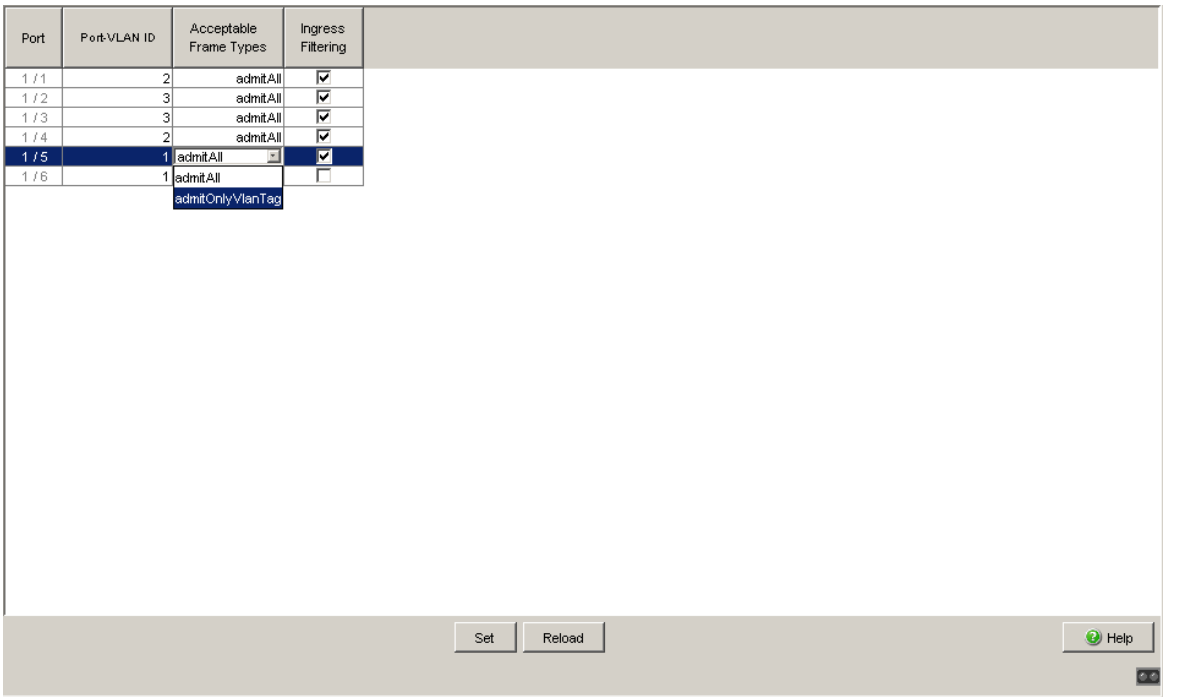


Figure 35: Assigning and saving "Port VLAN ID", "Acceptable Frame Types" and "Ingress Filtering"

- ☐ Because terminal devices usually do not send data packets with a tag, you select the `admitAll` setting for the terminal device ports. Configure the uplink port with `admit only VLAN tags`.
- ☐ Activate "Ingress Filtering" at the uplink port so that the VLAN tag is evaluated at this port.
- ☐ Click on "Set" to temporarily save the entry in the configuration.
- ☐ Open the `Basic Settings:External Memory` dialog.
- ☐ Make sure that the "Auto-save config on envm" checkbox is activated. To save the configuration permanently on the external memory, click on "Set".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`vlan participation include 1`	Port 1/1 becomes member untagged in VLAN 1.
`vlan participation include 2`	Port 1/1 becomes member untagged in VLAN 2.
`vlan tagging 2 enable`	Port 1/1 becomes member tagged in VLAN 2.
`vlan participation include 3`	Port 1/1 becomes member untagged in VLAN 3.
`vlan tagging 3 enable`	Port 1/1 becomes member tagged in VLAN 3.
`vlan pvid 1`	Port 1/1 is assigned the port VLAN ID 1.
`vlan ingressfilter`	Port 1/1 ingress filtering is activated.
`vlan acceptframe vlanonly`	Port 1/1 only forwards frames with a VLAN tag.
`exit`	Switch to the Configuration mode.
`interface 1/2`	Switch to the interface configuration mode for interface 1/2.
`vlan participation include 2`	Port 1/2 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/2 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.
`interface 1/3`	Switch to the Interface Configuration mode of Interface 1/3.
`vlan participation include 3`	Port 1/3 becomes member untagged in VLAN 3.
`vlan pvid 3`	Port 1/3 is assigned the port VLAN ID 3.
`exit`	Switch to the Configuration mode.
`interface 1/4`	Switch to the interface configuration mode of interface 1/4.
`vlan participation include 2`	Port 1/4 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/4 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.
`interface 1/5`	Switch to the interface configuration mode for port 1.5.
`vlan participation include 3`	Port 1/5 becomes member untagged in VLAN 3.
`vlan pvid 3`	Port 1/5 is assigned the port VLAN ID 3.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.

```
show vlan id 3                    Show details for VLAN 3.
VLAN ID.....................3
VLAN Name...................VLAN3
VLAN Type...................Static
VLAN Creation Time..........0 days, 00:07:47 (System Uptime)
VLAN Routing................disabled

Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1         Include   Include      Tagged
1/2         -         Autodetect   Untagged
1/3         Include   Include      Untagged
1/4         -         Autodetect   Untagged
1/5         Include   Include      Untagged
```

For further information on VLANs, see the reference manual and the integrated help function in the program.

10 Operation Diagnosis

The device provides you with the following diagnostic tools:

- Sending traps
- Monitoring the device status
- Out-of-band signaling via signal contact
- Port status indication
- Event counter at port level
- Detecting non-matching duplex modes
- SFP status display
- Reports
- Syslog
- Event log
- Selftest Dialog

10.1 Sending Traps

If unusual events occur during normal operation of the device, they are reported immediately to the management station. This is done by means of what are called traps - alarm messages - that bypass the polling procedure ("Polling" means querying the data stations at regular intervals). Traps make it possible to react quickly to unusual events.

Examples of such events are:

- a hardware reset
- changes to the configuration
- segmentation of a port
- …

Traps can be sent to various hosts to increase the transmission reliability for the messages. A trap message consists of a packet that is not acknowledged.
The device sends traps to those hosts that are entered in the trap destination table. The trap destination table can be configured with the management station via SNMP.

10.1.1 List of SNMP traps

The following table shows a list of possible traps that can be sent by the device.

Trap name	Meaning
authenticationFailure	This is sent if a station attempts to access an agent without authorisation.
coldStart	This is sent during the boot phase for both cold starts, after successful initialisation of the network management.
linkUp	This is sent when connection is established to a port.
linkDown	This is sent if the connection to a port is interrupted.
hm2DevMonSenseExt NvmRemoval	This is sent when the AutoConfiguration Adapter has been removed.
hm2DevMonSense Temperature	This is sent if the temperature exceeds the set threshold limits.
hm2DevMonSense PSState	This is sent if the power supply status changes.
hm2SigConStateChange	This is sent if the status of the signal contact changes in the operation monitoring.
hm2SigConChange	This is sent if the status of the signal contact changes in the operation monitoring.
alarmRisingThreshold	This is sent if the RMON input exceeds its upper threshold.
alarmFallingThreshold	This is sent if the RMON input goes below its lower threshold.
hm2SfpChangeTrap	This is sent when a supported or unsupported SFP device is inserted or removed.
hm2DiagSelftestAction Trap	This trap is sent if a selftest action is performed as configured for the four categories task, resource, software, and hardware.
hm2DiagIfaceUtilization Trap	This is sent if the interface threshold exceds the configured upper or lower limits.
hm2LogAuditStartNext Sector	This is sent when the audittrail has filled one sector and starts a new one.
hm2ConfigurationSaved Trap	This is sent after the device has successfully saved its configuration locally.
hm2ConfigurationChanged Trap	This is sent if you change the configuration of the device after saving locally for the first time.

Table 18: Possible traps

10.1.2 SNMP Traps when Booting

The device sends the ColdStart trap during every booting.

10.1.3 Configuring Traps

- ☐ Open the `Diagnostics:Alarms (Traps)` dialog.
- ☐ This dialog allows you to define to whom these traps are to be sent.
- ☐ Click on "Create".
- ☐ In the "Name" column you enter the name that the device uses to identify itself as the source of the trap.
- ☐ In the "Address" column you enter the IP address of the management station to which the traps are to be sent.
- ☐ In the "Active" column you select the entries that the device should take into account when it sends traps.
- ☐ The device generates traps for the changes selected in the `Diagnostics:Device Status` dialogs. The prerequisite is that you generate at least one SNMP manager in the `Diagnostics:Alarms (Traps)` dialog.

Note: You need read-write access for this dialog.

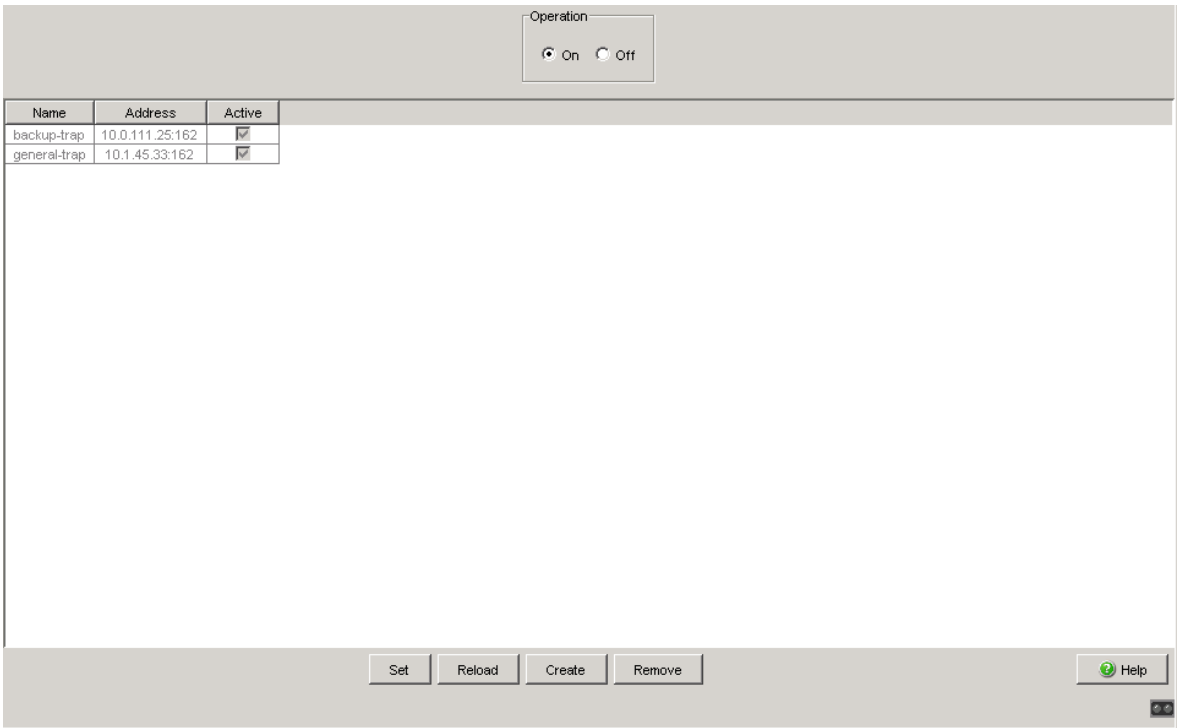


Figure 36: Alarms dialog

10.2 Monitoring the Device Status

The device status provides an overview of the overall condition of the device. Many process visualization systems record the device status for a device in order to present its condition in graphic form.

The device displays its current status as "Error" or "OK" in the "Device Status" frame. The device determines this status from the individual monitoring results.

The device enables you to:

- signal the out-of-band device status via a signal contact
  (see on page 155 “Monitoring the Device Status via the Signal Contact”)
- signal the device status by sending a trap when the device status changes
- detect the device status in the Web-based interface on the system side.
- query the device status in the Command Line Interface.

The device status of the device includes:

- Incorrect supply voltage
  - at least one of the 2 supply voltages is not operating,
  - the internal supply voltage is not operating.
- The temperature threshold has been exceeded or has not been reached.
- The removal of the external memory.
- The configuration on the external memory does not match that in the device. This feature is disabled on delivery.
- The interruption of link connection(s). You must configure at least one port for this feature. In the "Propagate Connection Error" frame of the `Diagnostics: Device Status` dialog, you define which ports the device signals if the connection is down . On delivery, the link monitoring is disabled.
  (see on page 157 “Displaying detected loss of connection”)

Select the corresponding entries to decide which events the device status includes.

10.2.1 Events which can be monitored

Name	Meaning
Temperature	If the temperature exceeds or falls below the value specified.
Connection error	The device sends a trap for every port link event in which the "Propagate Connection Error" checkbox is active.
ENVM removal	A trap is send if the ENVM is removed.
ENVM not in Sync	The device monitors sychronization between the device configuration and the configuration stored on the ENVM.
Power Supply	Mark the control box for power supply monitoring.

Table 19: "Device Status" events

10.2.2 Configuring the Device Status

- ☐ Open the `Diagnostics:Device Status` dialog.
- ☐ In the "Monitoring" field, you select the events you want to monitor.
- ☐ To monitor the temperature, you also set the temperature thresholds in the `Basic Settings:System` dialog at the end of the system data.
- ☐ Select the checkbox in the "Trap Configuration" frame.
- ☐ Configure at least one SNMP manager in the `Diagnostics: Alarms (Traps)` dialog.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`device-status monitor envm-not-in-sync`	Sets the monitoring of whether the external non-volatile memory and the current configuration match.
`device-status monitor envm-removal`	Sets the monitoring of the external non-volatile memory device removal.
`device-status monitor link-failure`	Sets the monitoring of the network connection
`device-status monitor power-supply 1`	Sets the monitoring of the power supply unit(s)
`device-status monitor temperature`	Sets the monitoring of the device temperature
`device-status trap`	Enable a trap to be sent if the device status changes.

Enable the port connection monitoring using the following CLI commands for each individual port.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Select interface 1 port 1.
`device-status link-alarm`	Enables the monitoring of the port link.

Note: The above CLI commands activate the monitoring and the trapping for the supported components. If you want to activate or deactivate monitoring only for individual components, you will find the corresponding syntax in the CLI manual or in the help of the CLI console. (Enter a question mark `?` for the CLI prompt.)

10.2.3 Displaying the Device Status

☐ Open the `Basic Settings:System` dialog.

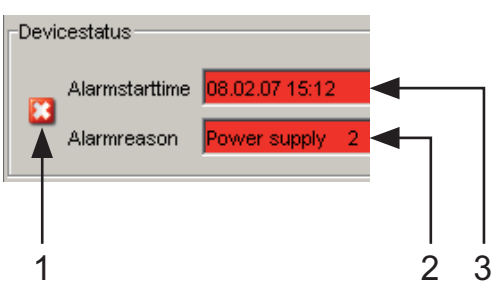


Figure 37: Device status and alarm display
1 - The symbol displays the device status
2 - Cause of the oldest existing alarm
3 - Start of the oldest existing alarm

`show device-status all`	In the EXEC Privilege mode, display the device status and the setting for the device status determination.

10.3 Out-of-band Signalling

The signal contact is used to control external devices and monitor the operation of the device. Function monitoring enables you to perform remote diagnostics.
The device reports the operating status via a break in the potential-free signal contact (relay contact, closed circuit):

- The temperature threshold has been exceeded or has not been reached.
- The interruption of link connection(s). You must configure at least one port for this feature. In the "Propagate Connection Error" frame, you define which ports the device signals if the connection is down . On delivery, there is no link monitoring.
- The removal of the external memory.
- The configuration on the external memory does not match that in the device.
- Incorrect supply voltage
  - at least one of the 2 supply voltages is not operating,
  - the internal supply voltage is not operating.

Select the corresponding entries to decide which events the device status includes.

Note: With a non-redundant voltage supply, the device reports the absence of a supply voltage. If you do not want this message to be displayed, feed the supply voltage over both inputs or switch off the monitoring (see on page 155 “Monitoring the Device Status via the Signal Contact”).

10.3.1 Controlling the Signal Contact

With this mode you can control this signal contact remotely.

Application options:

- Simulation of an error detected during SPS error monitoring.
- Remote control of a device via SNMP, such as switching on a camera.

☐ Open the `Diagnostics:Signal Contact` dialog.

☐ To activate the signal contact manually, you select the "Manual Setting" option in the `Signal Contact Mode` frame.

☐ To open the signal contact, you select the "Opened" option in the `Manual Setting` frame.

☐ To close the signal contact, you select the "Closed" option in the `Manual Setting` frame.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`signal-contact 1 mode manual`	Select the manual setting mode for signal contact 1.
`signal-contact 1 state open`	Open signal contact 1.
`signal-contact 1 state close`	Close signal contact 1.

10.3.2 Monitoring the Device Status via the Signal Contact

The "Device Status" option enables you, like in the function monitoring, to monitor the device status via the signal contact.
(see on page 150 “Monitoring the Device Status”)

Configuring the operation monitoring

- ☐ Open the `Diagnostics:Signal Contact` dialog.
- ☐ Select the `Monitoring Correct Operation` option in the "Signal Contact Mode" frame to use the signal contact to monitor the device functions.
- ☐ Select the `Monitoring` option in the "Monitoring Correct Operation" frame for the events to be monitored.
  You define the temperature thresholds for the temperature monitoring in the `Basics Settings:System` dialog.
- ☐ Select the checkbox in the "Trap Configuration" frame.
- ☐ Configure at least one SNMP manager in the `Diagnostics: Alarms (Traps)` dialog.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`signal-contact 1 monitor envm-not-in-sync`	Sets the monitoring of synchronization between the external non-volatile memory and the current configuration.
`signal-contact 1 monitor envm-removal`	Sets the monitoring of the external non-volatile memory device removal.
`signal-contact 1 monitor link-failure`	Sets the monitoring of the network connection
`signal-contact 1 monitor power-supply`	Sets the monitoring of the power supply
`signal-contact 1 monitor temperature`	Sets the monitoring of the device temperature
`signal-contact 1 trap`	Enables a trap to be sent if the status of the operation monitoring changes.
`no signal-contact 1 trap`	Disables a trap messaging.

Displaying the signal contact's status

The device gives you additional options for displaying the status of the signal contact:

- display in the Web-based interface,
- query in the Command Line Interface.

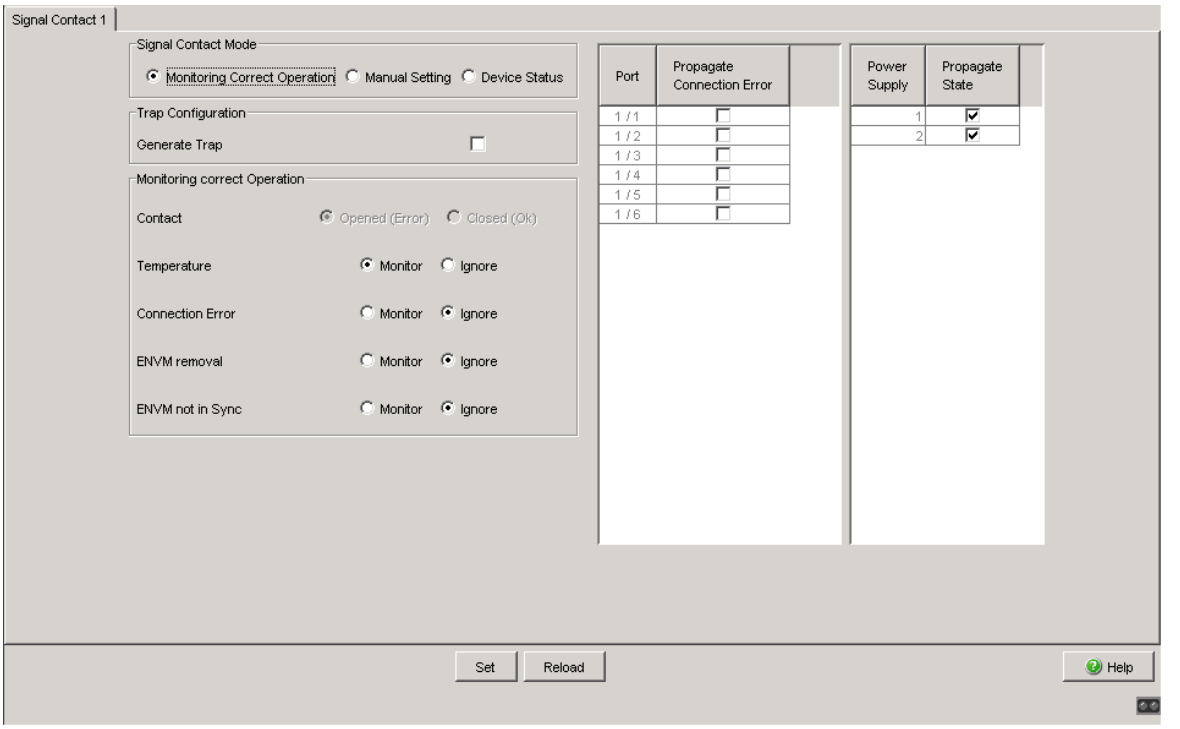


Figure 38: Signal Contact dialog

`exit`	Switch to the privileged EXEC mode.
`show signal-contact 1 all`	Displays signal contact settings for the specified signal contact.

10.3.3 Displaying detected loss of connection

In the delivery state, the device displays a detected loss of connection via the signal contact and the LED display. For signal contact operation, apply the procedure listed below to the `Diagnostics:Signal Contact` dialog. The device allows you to suppress this display. This prevents a switched off device from being interpreted as an interrupted connection, for example. You can configure the device to send a trap for a detected loss of connection. The device allows you to suppress this trap, because you could misinterpret a switched off device as an interrupted connection, for example.

- ☐ Open the `Diagnostics:Device Status` dialog.
- ☐ In the "Propagate connection error" column, select the ports for which you want to have link monitoring.
- ☐ In the "Trap Configuration" frame, check the control box to send a trap to the managing station.

  Note: At least one management station is configured.

Enable the port connection monitoring using the following CLI commands for each individual port.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Select interface 1 port 1.
`device-status link-alarm`	Enables the monitoring of the port link.

10.4 Port Status Indication

☐ Open the `Basic Settings:System` dialog.

The following symbols represent the status of the individual device ports. In some situations, some of these symbols interfere with one another. You get a full description of the port status when you position the mouse pointer over the port symbol.

Criterion	Symbol	
Bandwidth of the device port		10 Mbit/s Port activated, connection okay, full-duplex mode
		100 Mbit/s Port activated, connection okay, full-duplex mode
		1000 Mbit/s Port activated, connection okay, full-duplex mode
Operating mode		Half-duplex mode activated See the `Basic Settings:Port Configuration` dialog, "Automatic Configuration" checkbox.
Autonegotiation		Autonegotiation activated See the `Basic Settings:Port Configuration` dialog, "Automatic Configuration" checkbox.
AdminLink		Port is deactivated, connection okay
		Port is deactivated, no connection set up See `Basic Settings:Port Configuration` dialog, "Port on" checkbox and "Link/Current Settings" field.

Table 20: Symbols identifying the status of the device ports

10.5 Event Counter at Port Level

The port statistics table enables experienced network administrators to identify possible detected problems in the network.
This table shows you the contents of various event counters. In the `Basic Settings:Restart` dialog, you can reset the event counters to zero using "Cold start" or "Reset port counters".
The packet counters add up the events sent and the events received.

Counter	Indication of known possible weakness
Received fragments	▶ Non-functioning controller of the connected device. ▶ Electromagnetic interference in the transmission medium
Detected CRC errors	▶ Non-functioning controller of the connected device. ▶ Electromagnetic interference in the transmission medium ▶ Defective component in the network
Detected collisions	▶ Non-functioning controller of the connected device. ▶ Network range/line length too large ▶ Collision of a disturbance with a data packet

Table 21: Examples indicating known weaknesses

- ☐ The event counters may be obseverd by selecting the `Diagnostics:Ports:Statistics Table` dialog.
- ☐ To reset the counters, click on "Reset port counters" in the `Basic Settings:Restart` dialog.
- ☐ To monitor the current status of the event counters, open the `Diagnostics:Ports:Statistics Table` dialog and click the "Reload" button.

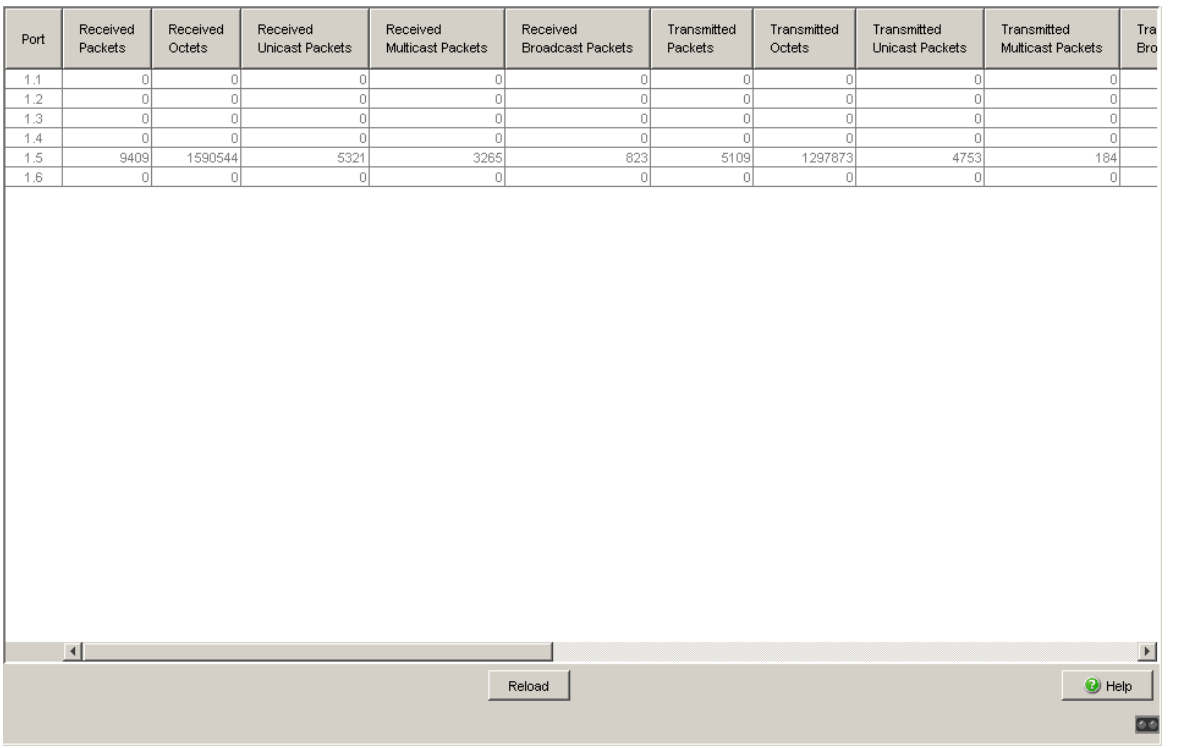

Port
Received Packets
Received Octets
Received Unicast Packets
Received Multicast Packets
Received Broadcast Packets
Transmitted Packets
Transmitted Octets
Transmitted Unicast Packets
Transmitted Multicast Packets
Tra
Bro
1.1 0 0 0 0 0 0 0 0 0 0
1.2 0 0 0 0 0 0 0 0 0 0
1.3 0 0 0 0 0 0 0 0 0 0
1.4 0 0 0 0 0 0 0 0 0 0
1.5 9409 1590544 5321 3265 823 5109 1297873 4753 184
1.6 0 0 0 0 0 0 0 0 0 0
Reload
Help

Figure 39: Port Statistics dialog

10.5.1 Detecting Non-matching Duplex Modes

If the duplex modes of 2 ports directly connected to each other do not match, this can cause problems that are difficult to track down. The automatic detection and reporting of this situation has the benefit of recognizing it before problems occur.

This situation can arise from an incorrect configuration, e.g. if you deactivate the automatic configuration on the remote port.

A typical effect of this non-matching is that at a low data rate, the connection seems to be functioning, but at a higher bi-directional traffic level the local device records a lot of CRC errors, and the connection falls significantly below its nominal capacity.

The device allows you to detect this situation and report it to the network management station. In the process, the device evaluates the error counters of the port in the context of the port settings.

Possible causes of port error events

The following table lists the duplex operating modes for TX ports, with the possible fault events. The meanings of terms used in the table are as follows:

- Collisions: In half-duplex mode, collisions mean normal operation.
- Duplex problem: Duplex modes do not match.
- EMI: Electromagnetic interference.
- Network extension: The network extension is too great, or too many hubs are cascaded.
- Collisions, late collisions: In full-duplex mode, the port does not count collisions or late collisions.
- CRC error: The device only evaluates these errors as non-matching duplex modes in the manual full duplex mode.

No.	Automatic configuration	Current duplex mode	Detected error events (≥ 10 after link up)	Duplex modes	Possible causes
1	On	Half duplex	None	OK	
2	On	Half duplex	Collisions	OK	
3	On	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
4	On	Half duplex	CRC error	OK	EMI
5	On	Full duplex	None	OK	
6	On	Full duplex	Collisions	OK	EMI
7	On	Full duplex	Late collisions	OK	EMI
8	On	Full duplex	CRC error	OK	EMI
9	Off	Half duplex	None	OK	
10	Off	Half duplex	Collisions	OK	
11	Off	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
12	Off	Half duplex	CRC error	OK	EMI
13	Off	Full duplex	None	OK	
14	Off	Full duplex	Collisions	OK	EMI
15	Off	Full duplex	Late collisions	OK	EMI
16	Off	Full duplex	CRC error	Duplex problem detected	Duplex problem, EMI

Table 22: Evaluation of non-matching of the duplex mode

10.6 Displaying the SFP Status

The SFP status display allows you to look at the current SFP module connections and their properties. The properties include:

- module type
- serial number of media module
- temperature in ° C
- transmission power in mW
- receive power in mW

☐ Open the `Diagnostics:Ports:SFP` dialog.

10.7 Reports

The following reports and buttons are available for the diagnostics:

- Global.
  Using this dialog you enable or disable where reports are sent e.g. Console, Syslog Server, or CLI connection. You also set at which severity level events are written into the reports.
- System Log file.
  The log file is an HTML file in which the device writes every important device-internal events.
- Persistent Logging.
  The device saves log entries in a file on the external memory, when installed. These files are available after power down. The maximum size, maximum number of files to be retained and the severity of events to be logged are configurable. The device archives the files once the file size is obtained and a new file is started. The device deletes the oldest file and renames the other files to maintain the configured number of files. It is posible to review these files using the CLI or copy them to an external server for future reference.
- System information.
  The system information is an HTML file containing the system-relevant data.
- Download Support Information.
  This button allows you to download system information as files in a ZIP archive.

In service situations, these reports provide the technician with the necessary information.

The following button is available as an alternative for operating the Web-based interface:

- Download JAR file.
  This button allows you to download the applet of the Web-based interface as a JAR file. Then you have the option to start the applet outside of a browser.
  This facilitates the device administration even when you have disabled its web server for security reasons.

☐ Open the `Diagnostics:Report:Global` dialog.

☐ Click on "Download Support Information".

☐ Select the directory in which you want to save the support information.

☐ Click on "Save".

The device creates the file name of the support information automatically in the format <IP address>_<system name>.zip.

☐ Click on "Download JAR-File".

☐ Select the directory in which you want to save the applet.

☐ Click on "Save".

The device creates the file name of the applet automatically in the format <device type><software version)>_<software revision of applet>.jar.

10.8 Syslog

The device enables you to send messages about important device-internal events to one or more syslog servers (up to 8). Additionally, you can also include SNMP requests to the device as events in the syslog.

Note: You will find the actual events that the device logged in the `Diagnostics:System Log` dialog (see page 167 “System Log”) and in the system log file (see on page 164 “Reports”) as an HTML page.

- ☐ Open the `Diagnostics:Report:Syslog` dialog.
- ☐ Activate the syslog function in the "Operation" frame.
- ☐ Click on "Create".
- ☐ In the "IP Address" column, enter the IP address of the syslog server to which the log entries are to be sent.
- ☐ In the "Port" column, enter the UDP port of the syslog server at which the syslog receives log entries. The default setting is `514`.
- ☐ In the "Minimum Severity" column, you enter the minimum severity an event must attain for the device to send a log entry to this syslog server.
- ☐ In the "Active" column, you select the syslog servers to which the device sends the logs.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`logging host add 1 addr 10.0.1.159 severity 3`	Add a new recipient of the log messages . The “3” indicates the seriousness of the message sent by the device. “3” means “error”.
`logging syslog operation`	Enable the Syslog function.
`exit`	Switch to the privileged EXEC mode.
`show logging host`	Display the syslog host settings.

```
No.    Server IP       Port   Max. Severity   Type         Status
-----  --------------- -----  --------------  ----------   -------
1      10.0.1.159      514    error           systemlog    active
```

10.9 System Log

The device allows you to call up a log of the system events. The table of the `Diagnostics:System Log` dialog lists the logged events.

- ☐ Click on "Reload" to update the content of the log.
- ☐ Click on "Search" to search the content of the log for a key word.
- ☐ Click on "Save" to archive the content of the log as an html file.

Note: You have the option to also send the logged events to one or more syslog servers
(see page 166 “Syslog”).

10.10Selftest Dialog

Disabling these functions lets you decrease the time required to reboot the device after a cold start. You can find these options in the `Diagnostics:Selftest` dialog, located in the "Configuration" frame.

- "Activate SysMon1" - to enable or disable the System Monitor function during a cold start.
- "Reload default config on error" - to enable or disable the reloading of the standard device configuration if no readable configuration is available during a restart.

Note: Device access is in jeopardy when you disable the System Monitor 1, for example, misplacement or misconfiguration of the administrator password.

A Setting up the Configuration Environment

A.1 Preparing access via SSH

To access the device through an SSH, follow the steps below:
- Generate a key (SSH Host Key).
- Install the key on the device.
- Enable access through an SSH on the device.
- Install a program that runs the SSH protocol (SSH client) on your computer.

A.1.1 Generating a key

OpenSSH gives experienced network administrators the option of generating the key. To generate the key, enter the following command:

```
genrsa -des3 -out privkey.pem 2048
dsaparam -out dsaparam.pem 1024
```

Creating a SSH Key using the Web Interface

You also have the option to generate the certificate directly on the device.

- ☐ You can generate a new DSA or RSA certificate using the "Create" button. You will find the corresponding function in the "Signature" frame, "SSH" tab, in the `Security:Management Access:Server` dialog.
- ☐ After generating the key, click on "Set". To activate the key, click on "Reload".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
ssh key dsa generate	Generate a new DSA key.

A.1.2 Uploading the key

The Web-based interface and the Command Line Interface enable you to upload the SSH key to the device.

☐ Save the key file on your PC.

☐ Select the "SSH" register in the `Security:Management access:Server` dialog. In the "Key Import" frame enter the URL path to the SSH Key. Enter the path in the text box either manually, or use the "…" button.

☐ After you enter the path in the text box, click "Import" to upload the SSH key to the device.

☐ After uploading the key, click on "Set". Click on "Reload" to activate the key.

☐ After generating the SSH key, copy it to a memory device. With the memory device properly installed, use the following commands to copy the SSH key.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`copy sshkey envm <file name>`	Copy SSH key from external non-volatile memory device.

A.1.3 Access through an SSH

One way of accessing your device through an SSH is by using the PuTTY program. This program is provided on the product-CD.

☐ Start the program by double-clicking on it.
☐ Enter the IP address of your device.
☐ Select "SSH".

☐ Click on "Open" to set up the connection to your device.
Depending on the device, and the time at which the SSH was configured, it may take up to a minute to establish the connection.

Just before the connection is established, the PuTTY program displays a security alarm message and gives you the option of checking the key fingerprint.

PuTTY Security Alert
WARNING - POTENTIAL SECURITY BREACH!
The server's host key does not match the one PuTTY has cached in the registry. This means that either the server administrator has changed the host key, or you have actually connected to another computer pretending to be the server.
The new rsa key fingerprint is:
1024 4e:62:99:32:56:07:26:1c:c5:39:55:e4:65:a9:f9:6e
If you were expecting this change and trust the new key, hit Yes to update PuTTY's cache and continue connecting.
If you want to carry on connecting but without updating the cache, hit No.
If you want to abandon the connection completely, hit Cancel. Hitting Cancel is the ONLY guaranteed safe choice.
Yes
No
Cancel
Help

Figure 40: Security alert prompt for the fingerprint

☐ Check the fingerprint of the key to ensure that you have actually connected to the desired device.
☐ If the fingerprint matches your key, click on "Yes".

PuTTY also displays another security alarm message at the defined warning threshold.

For experienced network administrators, another way of accessing your device through an SSH is by using the OpenSSH Suite. To open the connection, enter the following command:

```
ssh admin@10.0.112.53
```

`admin` for the user name.
`10.0.112.53` for the IP address of your device.

A.2 HTTPS Certificate

The web server uses HTTPS to load a Java applet for the web-based interface onto your computer. This applet then communicates with the device by SNMP (Simple Network Management Protocol). If you have enabled the `Security:Management Access:Server:HTTPS` function, the Java applet establishes an HTTPS connection to the device. The device creates an HTTPS tunnel through the SNMP. You can upload HTTPS certificates to the device.

- HTTPS Certificate Management.
- Access through HTTPS.

A.2.1 HTTPS Certificate Management

An X.509/PEM Standard certificate (Public Key Infrastructure) is required for the encryption. In the delivery state, a self-generated certificate is already present on the device.

- ☐ Open the `Security:Management Access:Server` dialog, "HTTPS" tab page.
- ☐ You generate a new X509/PEM certificate using the "Create" button in the "Certificate" frame.
- ☐ After generating the key, click on "Set".
- ☐ Restart the HTTPS server to activate the key. Restart the server via the Command Line Interface (CLI).

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`https certificate generate`	Generate a https X.509/PEM Certificate.
`no https server`	Disable HTTPS function.
`https server`	Enable HTTPS function.

You can also upload an externally generated X.509/PEM Standard certificate to the divice:

- ☐ In the `Security:Management Access:Server` dialog, open the "HTTPS" tab page.
- ☐ Enter the URL for the certificate in the "Certificate Import" frame, either manually or using the "..." browser button.
- ☐ Click on the "Import" button to copy the certificate to the device.
- ☐ You save the new certificate by actuating "Set" and then "Reload".

`enable`	Switch to the privileged EXEC mode.
`copy httpscert envm <file name>`	Copy HTTPS certificate from external non-volatile memory device.
`configure`	Switch to the Configuration mode.
`no https server`	Disable HTTPS function.
`https server`	Enable HTTPS function.

Note: If you upload or create a new certificate, be sure to reboot the device or the HTTPS server in order to activate the certificate. Restart the server via the Command Line Interface (CLI).

A.2.2 Access through HTTPS

Note: The standard port for HTTPS connection is TCP port 443. If you change the number of the HTTPS port, reboot the device or the HTTPS server in order to make the change effective.

- ☐ In the `Security:Management Access:Server` dialog, open the "HTTPS" tab page.
- ☐ In the "Operation" frame, select the option `On`.
- ☐ To access the device by HTTPS, enter HTTPS instead of HTTP in your browser, followed by the IP address of the device.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`https port 443`	Set the HTTPS port number for a secure HTTP connection. - As-delivered state: 443. - Value range: 1-65535
`https server`	Enable HTTPS function.
`show https`	Show the status of the HTTPS server and HTTPS port number.

If you make changes to the HTTPS port number, switch the HTTPS server off and then on again in order to make the changes effective.
The device uses HTTPS protocol and establishes a new connection. When the session is ended and the user logs out, the device terminates the connection.

B General Information

B.1 Management Information Base (MIB)

The Management Information Base (MIB) is designed in the form of an abstract tree structure.
The branching points are the object classes. The "leaves" of the MIB are called generic object classes.
If this is required for unique identification, the generic object classes are instantiated, i.e. the abstract structure is mapped onto reality, by specifying the port or the source address.
Values (integers, time ticks, counters or octet strings) are assigned to these instances; these values can be read and, in some cases, modified. The object description or object ID (OID) identifies the object class. The subidentifier (SID) is used to instantiate them.

Example:
The generic object class
`hm2PSState (OID = 1.3.6.1.4.1.248.11.11.1.1.1.1.2)`
is the description of the abstract information "power supply status". However, it is not possible to read any information from this, as the system does not know which power supply is meant.
Specifying the subidentifier (2) maps this abstract information onto reality (instantiates it), thus indicating the operating status of power supply 2. A value is assigned to this instance and can then be read. The instance "`get 1.3.6.1.4.1.248.11.11.1.1.1.1.2.1`“ returns the response "1", which means that the power supply is ready for operation.

Definition of the syntax terms used:	
Integer	An integer in the range -2^{31} - 2^{31}-1
IP Address	xxx.xxx.xxx.xxx (xxx = integer in the range 0-255)
MAC Address	12-digit hexadecimal number in accordance with ISO/IEC 8802-3
Object identifier	x.x.x.x… (e.g. 1.3.6.1.1.4.1.248…)
Octet string	ASCII character string
PSID	Power supply identifier (number of the power supply unit)
TimeTicks	Stopwatch, Elapsed time (in seconds) = numerical value / 100 Numerical value = integer in range 0-2^{32}-1
Timeout	Time value in hundredths of a second Time value = integer in range 0-2^{32}-1
Type field	4-digit hexadecimal number in accordance with ISO/IEC 8802-3
Counter	Integer (0-2^{32-1}), whose value is increased by 1 when certain events occur.

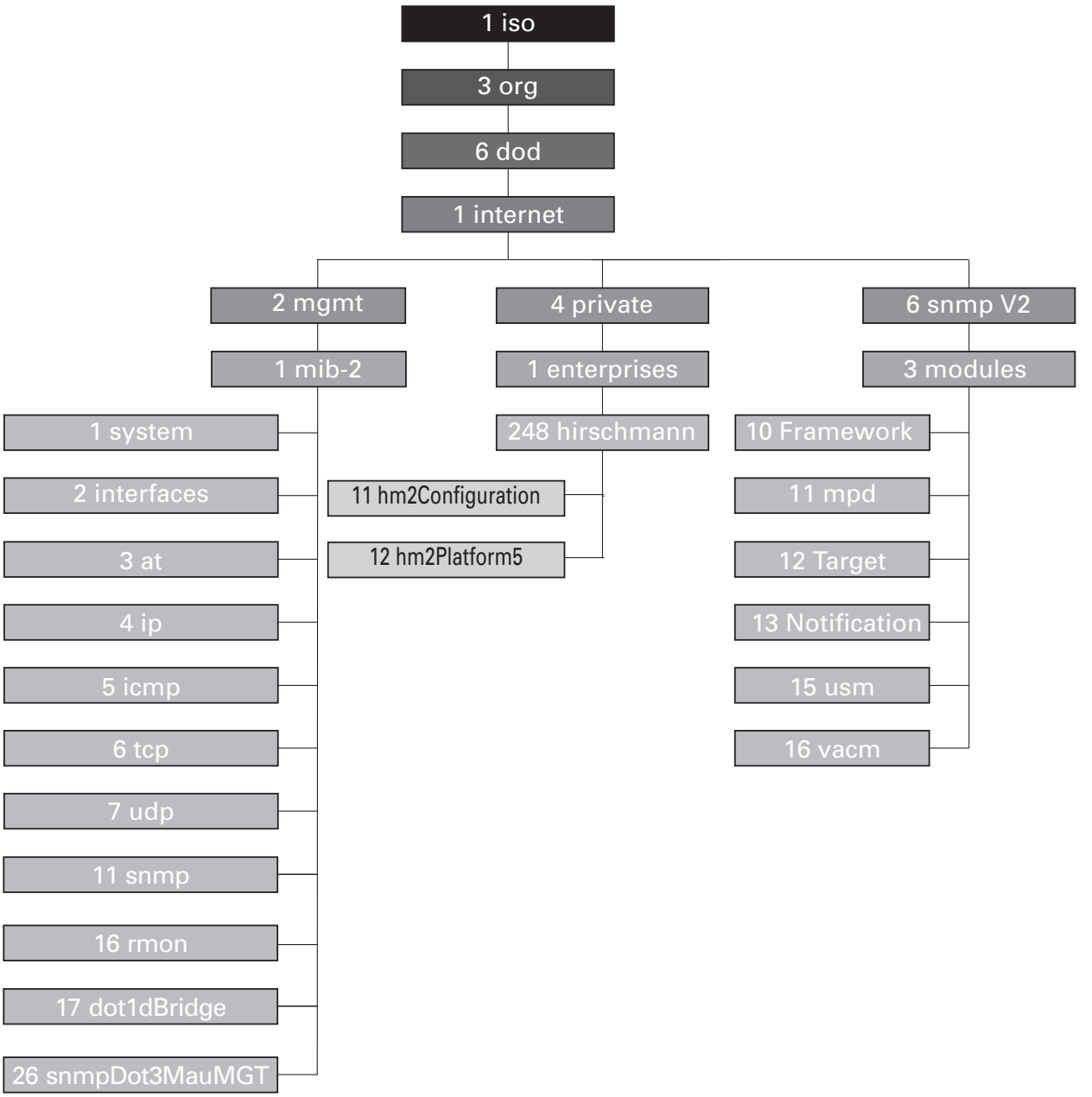


Figure 41: Tree structure of the Hirschmann MIB

A description of the MIB can be found on the product CD provided with the device.

B.2 Abbreviations used

ACA31	AutoConfiguration Adapter
ACL	Access Control List
BOOTP	Bootstrap Protocol
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
FDB	Forwarding Database
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocoll
LED	Light Emitting Diode
LLDP	Link Layer Discovery Protocol
F/O	Optical Fiber
MAC	Media Access Control
MSTP	Multiple Spanning Tree Protocol
NTP	Network Time Protocol
PC	Personal Computer
PTP	Precision Time Protocol
QoS	Quality of Service
RFC	Request For Comment
RM	Redundancy Manager
RS	Rail Switch
RSTP	Rapid Spanning Tree Protocol
SFP	Small Form-factor Pluggable
SFTP	SSH File Transfer Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TP	Twisted Pair
UDP	User Datagramm Protocol
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network

B.3 Technical Data

You will find the technical data in the document “GUI Reference Manual”.

B.4 Maintenance

Hirschmann is continually working to improve and develop our software. You should regularly check whether there is a new version of the software that provides you with additional benefits. You will find software information and downloads on the product pages of the Hirschmann website.

B.5 Readers' Comments

What is your opinion of this manual? We are constantly striving to provide as comprehensive a description of our product as possible, as well as important information to assist you in the operation of this product. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	Very Good	Good	Satisfactory	Mediocre	Poor
Precise description	O	O	O	O	O
Readability	O	O	O	O	O
Understandability	O	O	O	O	O
Examples	O	O	O	O	O
Structure	O	O	O	O	O
Comprehensive	O	O	O	O	O
Graphics	O	O	O	O	O
Drawings	O	O	O	O	O
Tables	O	O	O	O	O

Did you discover any errors in this manual?
If so, on what page?

Suggestions for improvement and additional information:

General comments:

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Dear User,

Please fill out and return this page

- as a fax to the number +49 (0)7127/14-1600 or
- per mail to

  Hirschmann Automation and Control GmbH
  Department 01RD-NT
  Stuttgarter Str. 45-51
  72654 Neckartenzlingen

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D Further Support

Technical Questions

For technical questions, please contact any Hirschmann dealer in your area or Hirschmann directly.

You will find the addresses of our partners on the Internet at http://www.hirschmann.com

Contact our support at https://hirschmann-support.belden.eu.com

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